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NASA Administrative Data Base Management Systems—1984

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NASA Headquarters
Washington, D.C.

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PREFACE

The third annual Technology Conference, sponsored by the NASA Headquarters ADP/Office Automation Management Branch, was held June 6 and 7, 1984 at Langley Research Center (LaRC). James D. Radosevich of the ADP/Office Automation Management Branch was conference chairman, Andrew Swanson was conference host, and Edna Davidson of BDSD was the conference coordinator at LaRC.

The purpose of these conferences is to provide an open forum for constructive information exchange among NASA technical Automatic Data Processing (ADP) personnel. The theme for each conference is selected by conducting a survey of NASA ADP personnel through the NASA Inter-Center Committee on ADP. Thus far all three conferences have had the same theme - NASA Administrative Data Base Management Systems.

The 71 conference attendees heard 17 presentations and participated in two roundtable discussions. Tours of some LaRC data processing and research facilities were conducted as part of the conference.

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STRATEGIES FOR CONVERTING TO A DBMS ENVIRONMENT

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Data Base Administrator
Ames Research Center

Ames Research Center(ARC) installed ADABAS on the administrative computer, an IBM4341 running VM/CMS. Prior to the installation of ADABAS, the only data base-like system used at Ames was a product called QBE (Query-by-Example). This product was installed and an extract of the payroll and personnel file was loaded as a table under QBE for use by the Personnel Office and Resources Management Office for ad hoc queries.

The strategy of converting to Data Base Management Systems processing techniques consists of three different strategies - one for each of the major stages in the development process. Each strategy was chosen for its approach in bringing about a smooth evolutionary type transition from one mode of operation to the next.

The initial strategy of what we call the "indoctrination stage" consisted of the following elements:

* Provide maximum access to current administrative data as soon as possible.

* Select and develop small prototype systems.

* Establish a user information center as a central focal point for user training and assistance.

* Develop a training program for programmers, management and ad hoc users in DBMS application and utilization.

Each of these strategies has one or more "sub-strategies" if you will. Each of tnese serves to highlight the purpose and intent of the main strategy.

By providing maximum access to current administrative data as quickly as possible, we hoped to achieve the following advantages:

1. Casually introduce on-line computing to the non-ADP professional with little impact on the current systems.

2. Provide training to the user community using the data they are familiar with and, thus, flattening the learning curve.

3. Decrease requests for AD HOC reports from the user as they gained proficiency in performing their own requests - resulting in more time available to the DP staff in developing ADABAS systems.

4. Providing a basis for determining efficiencies in file design based upon what type of queries the users performed.

5. Satisfy the users desire to have more access to their data.

The trade-offs were:

1. Possible system degradation due to less efficient file design, users performing inefficient queries, etc..

2. Too much freedom given to the users which may have to be taken away later.

3. Worst possible case - the user would be turned off immediately and develop a negative attitude toward on-line processing.

4. Enlarge the task of cleanup - to make data definitions conform to standards, etc..

To complement this approach, we developed a plan for establishing a user information center to serve as the central focal point for handling user training and assistance. The plan also called for developing training programs for DP personnel, management and ad hoc users.

Another part of the plan called for selecting and developing small "stand-alone" systems to provide needed computing capabilities where none existed.

Expected benefits of this particular strategy were:

1. Reduce the impact of non-experience by using less complicated systems.

2. Lessen the impact of system complexity in overcoming the learning curve.

3. Gain experience in developing on-line systems in DBMS environment.

4. Provide new service to user community and demonstrate the capabilities of the DBMS.

5. Development process could be used as initial guide to on-line systems development.

The last piece of the "indoctrination" strategy was to develop an effective training program for each of three groups of people.

1. The DP professional training consisted of specific training in the internals of the data base management system, courses in the procedural language and a seminar in applications development methodology.

2. The top and middle management training consisted mainly of a series of briefings and demonstrations.

3. The training for the Center ad hoc users was primarily an overview of the DBMS and specific instruction in the procedural language with emphasis on query. This training is provided on several levels from beginner through advanced. In addition, a selected group of users attended the seminar on PDM 80.

This strategy was rather straight forward and simple. There was little concern for efficient design, file layouts, normalization of entity classes, or any such buzzwords that you hear about today in the data base world. The emphasis was on experience and experimentation, learning what could be done with the data base and alternative ways of doing it. Without experience with a data base management system - and Ames had little of that - these "modern" concepts had little meaning and were difficult to relate to. These new ideas and concepts would become more important in the next stage of the development process, but the indoctrination stage was just that - indoctrinate the community to the new tool - the Data Base Management System. The fastest way to do that was to keep things simple. Before I go on to explain the components of the next stage of the development process, let me elaborate a little on the results of the initial stage.

The first step was to load the most used files from the current batch systems into the data base for access by the owners of the data for ad hoc reporting. The first files loaded were the personnel and payroll system file. The files were defined with little concern for standard data names and proper data base file design. The arrangement of the fields was based on a combination of the current record layout and a limited knowledge of what fields were most frequently accessed. The objective was to get the data into the data base. Some of the data was loaded and a few programs written to assist the personnel department in accessing the data. One such program was the individual employee record which basically displayed an individual employee's personnel status and action history on the screen. The other programs were a series of menu-driven which assisted the user in operating the system and developing queries without having to learn all the commands or syntax. The initial reaction was one of caution. The user was unsure of his capabilities to learn and effectively program queries with the new language NATURAL, which is considerably more complex than QBE which they had been using. However, it was only a matter of a month or two before they were using NATURAL exclusviely. This was due to several reasons: Primarily because the file loaded into ADABAS was more complete than the one in QBE and the ADABAS file was reloaded every day that an update had taken place, whereas the QBE file was loaded only at the end of each pay period. Other factors were the quicker response in ADABAS and the personnel department had hired a summer student who was eager to learn NATURAL and had developed some rather useful reports using NATURAL which greatly assisted the organization. Therefore, after a few short months, QBE was quietly phased out and the lease agreement terminated. ADABAS and NATURAL were accepted by the users. In fact, the user community was becoming excited over this new source of information and wanted more - not only from the data processing department - but they wanted more knowledge about the data base and NATURAL. They wanted to do more for themselves.

The logical place for the users to go was to the user information center that was established when QBE was installed, but had seen little activity. The users came here for answers. No formal training was provided yet for

the users. The training was concentrated on the DP personnel. Until that training was completed, training of the users could not commence.

With the help of Langley Research Center, we loaded files from other systems with the Data Base and we obtained "on loan", a highly qualified instructor to provide advanced NATURAL training to our DP staff and to assist in developing a formal training program for the user community. Meanwhile, development of three small systems in ADABAS and programmed primarily in NATURAL was under way. The three projects were:

1. LIRS II - a legal information retrieval system for maintaining an inventory of legal documents relating to the 80x120 Foot Wind Tunnel litigation.

2. TPS - Treasury Payments System for processing of miscellaneous payments.

3. System Documentation Library for maintaining inventory and control of systems documentation.

The LIRS II System was developed in four weeks with an additional two weeks spent in enhancing the query portion of the system.

The Treasury Payments System was developed in eight weeks.

The System Documentation Library was developed over a longer period of time, approximately ten weeks, by a programmer who had little experience in NATURAL programming. This system was later scrapped and redone within a two week period as a class project in advanced NATURAL techniques.

These three systems were selected for development based on three factors:

1. There was an immediate need for the data processing application and the system did not exist before.

2. Expected development cycle was short and if the system had to be redone, it could easily be accomplished.

3. The systems were not complex.

These three systems are still in operation today and require minimal maintenance - in fact - a routine maintenance schedule has not yet been established.

These three projects led to the development of NATURAL programming standards and system design standards, but most of all, they served to show the capabilities of ADABAS and the productivity of the NATURAL programming language to the DP department and to the Center.

By the end of the first phase of development (and there is no definite cutoff point between the first and second phase), it was evident that the DBMS dramatically and permanently changed the concepts and attitudes toward computing at Ames.

The user information center conducts regular, formal training classes for the user community. The users are finding that they can meet some of their information needs without the assistance of the DP department. Communications between the DP department and the users is at an all-time high. The user has learned the importance of their involvement in system design and development.

There are some negative aspects to this strategy which I will list below; however, these shortcomings were recognized at the inception. Dealing with these issues would be a major part of the second phase in the evolutionary process.

1. Security issues. Security of the data against unauthorized access or destruction was dealt with on a very low key basis. Minimal security precautions were established primarily to protect privacy data against unauthorized access and to insure integrity of on-line systems which did not have a backup batch system. While these security procedures are not foolproof, reports of the data base activity have shown no violations and there have been no problems detected.

2. Data dictionary role in the DBMS. Very little attention was paid to the data dictionary and its role in managing the data base environment. Consequently, the first phase saw no standardization of data names and data definitions, data redundancy and data relationships were not defined.

3. Data base tuning and capacity planning. Obviously this was nearly impossible in the first phase of our strategy primarily due to lack of any knowledge in this area.

This issue became important sooner than anticipated. With the installation of the NEMS System, the data base performance ground to a snail's pace. Within a couple of weeks, however, through adjusting of buffer areas and some blocking factors of data base data sets, the performance was brought back to a tolerable level. Still, I was not satisfied and could foresee difficulties in the near future if performance could not be improved. The performance did not appear to be as efficient as some COMPLETE users were experiencing. To make a long story short, we finally came across the fact that CMS was single threading all of its I/O, and that Cornell University had developed BDAM emulation software which allowed overlapping of I/O. Within another couple of weeks, we had installed the software on the data base machine and were experiencing a ten-fold improvement in response times.

Overall, the objectives of the first phase of the strategy were well achieved. The users could now have access to their data in a realtime sense. They were well on their way to being able to ask the right questions and getting the right answers to those questions without waiting in line at the data processing department door.

The second phase is well under way. The main objective of the second phase is to develop an effective, efficient and viable methodology for developing, maintaining and utilizing the Center's information resources.

In this phase, the issues of security, data structures, file structures, and proper data defintions become important. To assist us and to get exposure to the latest methodologies in data base development, we hired UCLA professor, Dr. Alphonso Cardenas, to provide a seminar on his methodology "PDM 80" and to provide consulting services during the first development project using his methodology. That project started in January of this year and is scheduled for completion in August. It is planned that the results will be a system with a well documented, developmental methodology that will serve as a model or prototype for all future development efforts. The project encompasses the R&PM functions of the Resources Management Office.

Also scheduled in this phase, is the installation of NATURAL security and the development of required procedures to assure data integrity, protection of sensitive data from unauthorized disclosure, and protect the entire data resource from destruction.

Another important issue in the second phase is the development of a truly integrated data dictionary system. The objectives of the data dictionary are:

1. Document and define all the entities, attributes, classes and relationships that comprise the Center's information resource.

2. Standardize data names by establishing naming conventions.

3. Define systems, programs, files and data elements used in them.

4. Define the owners of the data.

5. Provide the capability for determining and subsequently managing data and system changes.

I might add that included in this data dictionary is all data considered to be part of the Center's information resource regardless of where it resides.

Finally when this is all accomplished, we are ready for the final phase in evolving toward DBMS technology and that is the incorporation of the data bases into a complete automated office management system. "Office automation" to use the buzz word of today.

Even today with the increasing use of the micro-computers as work stations with their own data base systems, word processors, and communications with he main-frame, office automation is a fact of life at Ames and is rapidly increasing.

Many of the organizations at Ames, especially in the administrative areas, have in one short year gone from computer-phobia to computer-literacy. The data processing department is evolving from that of the doer to the role of the consultant.

What's ahead for Ames? In the short term, SOFTWARE AG has offered to allow Ames to test their new ADABAS/VMS product for the VAX. Currently, Ames is loading financial data from the IBM Financial System onto one of the VAX machines and using INGRES to query the data.

The test period will be used to compare the two DBMS'. If ADABAS performs as well as INGRES, we would then purchase ADABAS/VMS which will allow us to transport the NATURAL programs from the IBM to the VAX.

Several menu-driven, ad hoc query facilities have been developed which provides the capability for the user to extract data from the data base files without seeing or using one word of NATURAL language. One of the systems allows the user to export data to his micro-computer for use by a micro-based data base system such as Lotus 1-2-3. These systems have been a real hit with the users and more of these are in the planning stage.

Conclusions:

Starting small is important.

Several small systems developed implemented will achieve immediate recognition and subsequently, strong support for the capabilities of the system and the DP department. Starting small will allow your DP professionals to gain experience, and at the same time, achieve some demonstrative successes.

Access is the key to success.

Provide the user with the access to his data and with a small selection of software products or tools for the user to manipulate the data. Use the information center to train and assist the users; to answer their questions; to develop their skills in writing their own programs.

User information center is vital to success.

At first, if the center is nothing more than that of a solution center, i.e., providing answers to users questions on how to write a query, it will still serve to nurture the non-DP professional in finding his own solutions. In fact, in some instances, you may even find the information center personnel benefiting from the approach of some users. It seems as

an exchange center - an exchange of ideas and techniques between the administrative professional and the data processing professional. Result: a more solid knowledge base for developing applications and an atomosphere of cooperation and common interests. It serves to gradually bring about a change from the old method of the users tasking the DP department with an application or problem, and the DP department providing a solution which often the user is not completely satisfied with, to a new attitude.

1. One of working together to achieve a common purpose.

2. One in which the user shares in the responsibility and credit for the success of a project.

Nearly all of the modern DBMS development methodologies today, stress the importance of a well defined, comprehensive integrated data dictionary. I strongly agree with that concept. It should be the map of the data base system, but don't waste effort on attempting to standardize data names of existing files being loaded into the DBMS. Load the file with the existing names, define them as well as reasonably possible, but remember to start - the key is access. Often using names that the user is familiar with is the best course in getting them through the indoctrination phase - and the advanced user is an excellent source for developing names and definitions of the data during the later phases of development.

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EFFECTIVE ORGANIZATIONAL SOLUTIONS FOR IMPLEMENTATION OF DBMS SOFTWARE PACKAGES

By: Doug Jones

Introduction/Strategic Plan

This paper will use the Space Telescope Management Information System development effort as a guideline for discussing effective organizational solutions used in implementing DBMS Software. The paper will not attempt to be all inclusive but rather will focus on the importance of strategic planning. In addition, methodologies will be examined that offer viable alternatives for successfully implementing DBMS software.

The paradigm for effective implementation of a Management Information System (MIS) is a strategic plan. The idea of the strategic plan is straightforward in concept: where do you want to be and how do you get there. More importantly, it is the background against which the necessary managerial and technical tradeoffs are made in order to successfully implement a Database Management System (DBMS) as part of the MIS effort.

It has been found to be useful by system development teams to express this strategic plan visually as an Information System Architecture. The general recommendation is to a avoid a rigid detailed hardware/software architecture which is incapable of responding to evolving managerial needs. Instead, the guiding principle is to construct the architecture to conform to the organization's management structure. This management structure or organizational setting includes the consideration as to whether the operation is centralized or decentralized, and what is the prevalent management philosophy.

This information system architecture does not have to be complex. In fact, simplicity is an asset. A few diagrammatic representations can prove to be very effective. As decision alternatives are developed, such as shifts in requirements, vendor evaluations, or software selection, they are all examined with respect to this Information System Architecture. It is several of these major decision alternatives which will be discussed, and implementation alternatives offered.

In harmony with this strategic plan, there must be a senior decision maker, functioning as the architect of the Information System Architecture. This authority should be one individual, or certainly no more than a few individuals, who can accurately determine and enforce organizational requirements.

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For the NASA Space Telescope Program, this Information System Architecture includes the general requirement to integrate contractor financial data, reported via a diverse management tracking structure, with relevant program technical feedback. This data must be combined and reported in a timely fashion. More specific requirement goals were included, outlining the specific types and level of program financial data and the specific technical data needed. The organizational setting was complicated by the fact that the Space Telescope Program is a major NASA program, which at the time of the MIS start-up was well underway in terms of time and total dollar expenditures. The strategic plan included a need for offering a benefit to the on-going program in the near term, and the development of a system to meet future NASA program requirements. For the NASA Space Telescope Program Management Information System, the crucial chief architect role belongs to Mr. James Welch, NASA Space Telescope Program Manager.

Shifting User Requirements

The most immediate difficulty for implementation of a DBMS package, or any software system, is dealing effectively with shifting user requirements. All projects, whether they are software or engineering, involve a series of calculated trade-offs made during the difficult course to completion. Taken in this context, the problem of shifting requirements should not be surprising, nor unexpected.

Even more important than this realization, is the crucial combination of establishing a baseline requirement and top management commitment. It is this combination that permits effective solutions for handling shifting requirements. The importance of a strategic plan expressed as an Information System Architecture for establishing top management commitment has been discussed. One effective tool for establishing the baseline requirement is prototyping. Prototyping is the process whereby an initial working software system is constructed for presentation to management and the user community. In fact, the presentation process is the key. The goal of the presentation is to make the users an integral part of the development process. By demonstrating an electronic strawman early in the development cycle, users are presented with less of an abstraction than a simple verbal or written explanation would lend. This electronic strawman allows the system developers to elicit meaningful responses from selected users early on in the course of system development. This electronic strawman can be as simple as a series of example screen formats that may be paged through in the manner that the proposed system will function.

As development continues, the prototype continues as the vehicle for acceptance of changing requirements. It is important to note that this prototyping approach accurately reflects the iterative nature of software development. Changes will continue to be received and accepted as they are approved. Management's expectations should not reflect a static system, but rather should be for a controlled audit trail of changes, all of which relate back to the strategic plan as expressed in the Information System Architecture.

For the Space Telescope Program the prototype Program Management Information System (PMIS) has been completed. This PMIS 1.0, representing the baseline requirements, was accomplished using the Digital Equipment Corporation (DEC) VAX 11/780 executing the INFO Database Management System. In addition to continued user training, production control procedures are being established to identify, implement, and monitor requested changes to the PMIS 1.0 System. As data loading continues, it is expected that further enhancements will continue to be made.

DBMS Vendor

After establishment of a strategic plan in the form of the Information System Architecture, another early and crucial issue in the chronology of MIS development is the establishment of a reliable working relationship with the DBMS vendor. This is an important step, whether or not the DBMS package has already been selected. If the DBMS evaluation is being done, vendor support becomes one of the decision criteria. If an existing DBMS is already in place and is satisfactory, it still benefits the project to review the nature and quality of vendor support. Vendor support is always important because the vendor can be the major link to viable alternatives for use of the software product, both during and after the software development effort.

Foremost in the evaluation of vendor support is their perceived ability to meet the organizational goals, as outlined in the Information System Architecture. This however, is the composite of many indicators. One recommended first step is a phone call to other user sites, followed by visits and evaluations of these operations. This should yield a realistic impression of the sites relative success and quality of on-site support. Users who are performing a similar operation to the proposed plan are the most valuable contacts. As part of this initial evaluation, the financial position of the vendor should be examined to ensure at least the possibility for a long-term relationship.

Another valuable indicator for evaluation is vendor supplied training, and the existence of a user group. The emphasis placed on training is a strong indication of the vendors intent to support the user sites for the long-term. In particular, multiple class offerings both on and off-site with flexible scheduling are all positive signs for vendor support. In addition, a strong user group can be a considerable asset. The user group can be another source for training and creative ideas for use of the DBMS product. No one single vendor will put their product to the variety of uses that a user community will in just a short period of time. During this second phase of evaluation, plans should be formulated to ensure staff training and making contacts for later direct support.

Another consideration is the vendors' philosophy towards processing maintenance requests and changes to their DBMS product. Maintenance requests should be handled in a disciplined fashion. The presence of a strong user group can yield additional leverage for insistence that a selected change be implemented. Another leverage factor is the size of your account and the type of work you are proposing. A project for a large organization, that is making full use of a vendor's product will command the vendors attention. Such a relationship can be advantageous to both sides. The user gets prompt attention while the vendor gains potential marketing advantage. With more hardware vendors supporting DBMS products, a user with large dollar expenditures tied up in hardware may consider using the same vendors DBMS software. Bargaining leverage is gained and technical risks may be minimized because the software was developed for the hardware in question. Finally, the contract itself offers the possibility for bargaining leverage. A lease agreement may make better financial sense and offers greater bargaining flexibility than an outright purchase. In particular, the prototype process allows real time evaluation before commiting to a product.

Whether the DBMS package has been procured or not, a technical evaluation should be made to determine compatability with design requirements. This subject is thoroughly discussed in current literature and will not be greatly expanded on here. One consideration does ,however, deserve emphasis. Any DBMS package selected will be lacking with respect to some capability or capabilities desired by the user community. This is why the types and likely strengths of your leverage should be evaluated beforehand. The reality of work-arounds will soon become apparent. Work-arounds is the concept of seeking alternative software solutions for a problem that is unresolvable in the short-term. This inevitability should be reflected in the evaluation process. A more complex DBMS is more difficult to manipulate. Make sure the application(s) planned require the degree of complexity you are buying. Again, the prototype process can be useful in making this final determination of DBMS suitablility.

For the Space Telescope Management Information System, the alliance with the software DBMS vendor was complicated by an intermediate agreement with another third-party vendor. This lead to some negotiating difficulties when faced with technical deficiencies with the DBMS. This situation was resolved within the vendor's organization by using the leverage NASA had due to the lease agreement, and the implied pressure of negative publicity because of the importance of the NASA account.

Admittedly, it is more difficult to break-out intermediate deliverables for tasks such as development of the DBMS system calculation logic. For such tasks, the recommendation is to break them down to correspond to the functional capability of the system. For instance, the calculation logic may be broken out into three sections. The input of the data to be calculated, performing the calculations, and reporting the calculation results. To the development staff the process is of course, more complicated. But, this approach is more understandable to general management. It is the responsibility of the system developers to represent the difference in relative difficulty by demonstrating time differences in the schedule. For the calculation logic example, the necessary design, writing, and testing of the calculation logic is more difficult than either inputting the data to be calculated , or moving the results to be reported.

For the Space Telescope Management Information System this general approach was followed. A time schedule with associated deliverables was established and reported to. Of the three schedule delays identified, only one was related to a software problem with the INFO DBMS. In all cases the underlying problem for the delay was worked until a solution was reached.

Supporting Management

Effective implementation of a DBMS requires the continuing support of management considerations. The strategic plan is the starting point for establishing management commitment. The prototype is an excellent tool for handling shifting requirements. Vendor support is a requirement for identifying viable software solutions. Everything is set except for the time line of development. Continued management support requires an accompanying schedule.

The system development staff should be able to track and report to a time line at all times. The idea of a strategic plan and corresponding schedule is not a revolutionary concept. However, since software projects are frequently late, it is equally obvious that merely developing a schedule is not adequate. Several suggestions are in order.

The reality of shifting requirements has been discussed. Such shifts need to be documented and approved. The prototyping approach allows for inclusion of these changes, which is important to prevent uninterrupted development. In parallel these changes must be noted with respect to the changes in schedule. The realities of schedule slippages should be discussed immediately and not appear as a surprise on the original anticipated project complete date. Tracking the inevitable deviations from the original plan in concert with the prototype development is an on-going process.

In order to fine-tune this process, system developers have found it useful to establish intermediate product deliverables throughout the lifecycle development process. The purpose of this effort is to prevent serious misunderstandings from being identified late in the development process. Although the complete DBMS-based software system is the final deliverable, there are identifiable intermediate products which demonstrate progress to that goal. This methodology forces a prior planning approach to be initiated. For instance, a working electronic prototype is the logical product deliverable of a functional specification. The prototype might include one dozen screens and the ability to view the screens in the same relationship as in the final system. The deliverable schedule might have included the completion of two electronic screens per week. Difficulty in agreement with a screen format would appear as a delay in completion of the particular electronic screen in question. By identifying the specific delay point the system development staff avoids appearing unaware of the schedule and can more effectively identify delay points. These delays are not of themselves a software problem.

Post Development Control

The majority of the alternatives discussed so far have pertained to solutions applied during the development phase. To complete the discussion of effective implementation of DBMS software, viable mechanisms must be discussed for continued effective use. The strategic plan should continue as the cornerstone of the maintenance effort. As the development effort transitions to a close, it is imperative to establish specific control structures. These controls fall into three areas. Production software control, production data control, and scheduled software enhancements. As the system is released into the user community, changes will be required to satisfy the user community. In all three cases it is important to track adjustments in a regulated fashion.

A simple but proven technique is control forms. These forms should detail the requested change or difficulty, a description of the change or difficulty, requested date, and description of the solution. In addition, the system development staff should arrange for assignment of responsibility and provide for management signoffs. The desired result is an audit trail of controlled changes. Such control forms are appropriate for any of these three areas. For legitimate scheduled enhancements, where the scheduled work is more than a few days, prior review approval is necessary before starting.

The Space Telescope Management Information System is now entering this post development phase of implementation. Control forms for data changes, software changes, and enhancements have been created. Initial system changes have been requested and implemented.

Summary

The purpose of this paper has been to discuss effective organizational solutions for implementing DBMS software. Paramount to this successful implementation effort is development of a strategic plan. For Management Information Systems (MIS) this is often expressed visually in an Information System Architecture. The purpose of this Architecture is to gain top mangement commitment. Most importantly, this strategic plan should reflect the organizations' structure. If the orgainization is decentralized then the information gathering and dissemination plan must reflect this reality. In the context of the Space Telescope Program this organization structure included the demands of an on-going program with the requirement to integrate diversely reported financial data with selected relevant technical feedback.

The most immediate difficulty in implementating DBMS software is dealing with shifting user requirements. This problem was set in the context of calculated trade-offs, a reality for any project. Prototyping, the creation of an initial working system, is a powerful tool to establish the baseline requirement. Users are made an integral part of the development process in reviewing this so called electronic strawman. With continued development, the prototype continues as the vehicle for accepting change, reflecting the iterative nature of software.

Another traditional problem with implementation has been the establishment of reliable DBMS vendor support. For this, techniques are less of an issue, rather the evaluation should center on a series of factors in which to make a weighted estimate. Emphasis should be concerned with the likely leverage the user may have in case of difficulty. The financial strength of the vendor should be examined as well as evaluation of other user sites. Other important considerations include, a strong user group, and a vendor who supplies the hardware and the DBMS. Signing a lease agreement may be a more powerful lever than a purchase agreement. The technical evaluation should ask the question, does the application require the degree of complexity that the DBMS software offers. More complexity translates to a longer learning time and possibly more maintenance difficulties.

As the develoment lifecycle continues, management considerations must continue to be supported. Although the prototype continues to demonstrate the development effort, a schedule is esssential to demonstrate progress against a defined timeline. Because software development is a recursive activity and shifting requirements are a reality, it has been demonstrated to be useful to identify intermediate deliverables. These deliverables should be expressed in functional terms that a general user could understand. This will be important because as delays are identified management will need to be informed. Many delays in implementation of DBMS software are not directly software related. An accurate means of identifying these sticking points will permit an accurate determination of the underlying difficulty and permit a managment decision to be made. Intermediate product deliverables are a form of development insurance.

As development winds down, the importance of continued monitoring does not diminish. Continued support falls into three areas: prodution software control; production data control; and software enhancements. For all these areas a regulated means of tracking is essential. Production control forms are one such way of providing an audit trail of changes. These forms should include requestor, change requested, description of change or problem identified, accompanying description, and provision for approval signoff.

The dynamics of a DBMS implementation are many. No technique discussed here is dificult to understand, many were borrowed from other fields of study. If there is one key it is the discipline to maintain the effort necessary to see the Management Information System successfully implemented.

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ADMINISTRATIVE AUTOMATION IN A SCIENTIFIC ENVIRONMENT

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GODDARD SPACE FLIGHT CENTER

One need only examine NASA's accomplishments haver its brief 25-year history to be assured that the talen and capability exist to accomplish virtually any technological goal it might pursue. NASA/Goddard Space Flight Center (GSFC) with its many experts, renowned scientists, and some of the most sophisticated computers in the world, played a major part in these accomplishments. One would think that a scientific environment then must be the ideal place to carry out administrative duties too.

In 1981, after having worked on the administrative side of the house for many years, the big opportunity arose to automate a scientific directorate in the management management of its resources, manpower, travel, Research Technology Objectives and Plans (RTOPs), physical space, etc. Again, one would think that a scientific directorate would not only be receptive to using automation for administrative functions, but would insist on it. Surprisingly, although the scientific personnel were advanced in the development and use of hardware and software for scientific applications, resistance to the use of automation or purchase of terminals, software and services, specifically for administrative functions was widespread. There was skepticism that automation would lead to more information gathering, more paper, extra work, loss of control, and ultimately less productivity. The perception was that the Center had a Management Systems Office that was responsible for the Center administrative databases that would meet most requirements. Although there were numerous complaints about timeliness of reports, inability to interact with the system and admittedly, using manual calculations from several reports in order to provide analysis was an archaic process for these times; there were generally negative reactions toward efforts to improve the situation. The following saying by Nicolo Machiavelli really seemed appropriate.

> "There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things, because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new."

What does an administrative manager do when faced with this situation, a shortage of personnel to proceed, and ever-increasing internal management, Center and Headquarters requirements for information? A clue from one of the more understanding scientists made sense, "you've got to show them it will work, and demonstrate mprovements, before you'll get scientific management support." This paper will highlight our approach to automating in this environment, some problems/constraints, acceptance and future plans in this area.

APPROACH/PROBLEMS AND CONSTRAINTS

Realizing that automation would have to occur without full management commitment and using existing equipment and personnel where possible, we first tackled the areas that were the most labor intensive or that received the most complaints. A detailed review of the previous method of providing information was conducted and the problems associated with each were highlighted. The IBM 4341 is the host for administrative computing at Goddard and terminals,

printers and modems of various types were available around the Center. The existing software was and still is the RAMIS II Data Base Management System. The IBM Time Sharing Option (TSO) utility was also available to allow more efficient use of RAMIS.

One of the most important factors in accomplishing a job is to acquire the appropriately skilled and motivated personnel. With this in mind, some people changes and additions occurred resulting in a team of three who were not experts in ADP, but who had the ability to learn and possessed the right attitude. Training was identified and provided and contacts with ADP experts on the Center were established.

Although it was difficult to obtain priority from the Center's Management Systems Office to have them automate our priorities, the assistance provided on specific technical questions was outstanding. In retrospect, although it took a long time and much patience, it was probably better because there now exists a base of knowledge from which to expand.

Another problem was trying to find time with the heavy workload to take training and learn to develop programs and systems. The perception from the scientific side was that the administrative staff had increased and results were not immediate. Managers need to be aware that automation does take more resources initially, but the benefits in the long run far outweigh this initial investment. Efforts utilizing existing data as much as possible, developing programs that provide more valuable and useful analyses, and prompter reporting, have shown some skeptical managers that automation can improve management. The administrative staff was provided training and support and improvements have been made on initial attempts. As with any system, the bugs had to be found through use before they could be addressed and problems solved.

An additional problem was data input. Improved software, full screen editors, increased training, contractor support and priority assistance from MSO have helped alleviate this problem. As user-friendly full screen data entry systems are developed, clerical staff will be able to provide support in this area.

The increased use of CRT terminals is a significant change in the office environment. Based on our experience, it has become clear that ergonomic concerns must be addressed. Proper lighting and furniture designed to provide support for the worker who will spend extended periods sitting at a video terminal are imperative. This is part of the initial investment but will result in increased productivity and a healthier and more motivated staff.

ACCEPTANCE

Over the past several years, most of the administrative function areas that fell under my auspices have been automated, i.e., RTOPs, manpower, travel, reimbursable agreements, physical space, various inventories, etc. A clue from one scientist --- to show the scientific managers through better analysis, manipulation of data to suit their own desires, better and more timely information, elimination of paperwork, -- proved correct. Although it took time to gain acceptance, scientific management encouraged us to present a Center Workshop on the Administrative databases developed for the Applications

Directorate that had Center-wide application. The Workshop was held on March 16, 1983, with approximately 100 attendees from virtually every directorate at the Center. Each staff member presented the portions with which he had been most involved, highlighting where the requirement originated, the old method of obtaining the information, the new automated method and the benefits derived. The need for sharing information, equipment and talent where similar requirements exist was stressed and the response was almost overwhelming. From that workshop, Center needs were identified and the results were presented to our management who arranged for us to present our findings to the Deputy Director of the Center and other top management who were in a position to take action. In addition to sharing information and expertise, the training of personnel on the use of existing systems was a problem across the Center.

Several positive things happened from those presentations. A Center Administrative Information Processing Planning Committee (AIPPC) was established with a representative from each directorate, whose mission is: to provide a forum for directorate administrative users to keep abreast of current developments in office automation technologies and to exchange information on use of office automation in their areas; to identify specific areas within the Center where office automation application can lead to greater efficiencies and significant manpower and cost savings; to work toward implementation of automated techniques in these areas and to develop a set of recommendations for implementing technologies, including specific recommendation on hardware/software purchase and use.

A training sub-committee was established under the AIPPC whose primary responsibility was to identify specific training needs for the Center user community, to create an information exchange and to increase awareness of existing administrative programs and systems (hardware and software). Some achievements to date include publishing an ADP Assistance Directory for Business/Resources Applications which includes name of employee, extension, building and room number, type of equipment used, resource applications, and available software. These people volunteered to assist others and it included scientific as well as administrative personnel. The Committee also identified specific training needs and presented them to the training office which is resulting in additional funding for FY85. The AIPPC committee is on-going and is in the process of preparing a report on overall accomplishments to date.

In our own directorate, an Applications Advisory Group for Automation of Administrative Functions (AAGAAF) was formed in January 1983, with a representative from each division — some scientists and some administrative personnel. The general goals of the group evolved as follows:

- To educate ourselves on current developments in office automation technologies, and to exchange information on their use.

- To identify specific areas within our area where automation of administrative functions can lead to greater efficiencies and significant manpower and cost savings, and to work towards the implementation of automated techniques in these areas.

- To develop a set of recommendations for implementing new technologies, including specific hardware and software purchases.

The group met approximately once a month and the first several meetings consisted of setting goals and gathering information, primarily by scheduling a series of speakers to report on developments in automation at Goddard Space Flight Center and NASA Headquarters. Subsequent meetings addressed specific problem areas where automated techniques would be useful.

1. A master list of problem areas was generated and individuals or groups are working on solutions.

2. An RTOP subcommittee was formed to investigate methods of reducing the effort spent on preparing the directorate response to the RTOP call. The goal was to have new procedures implemented in time for the FY85 RTOP cycle and the Full Screen Manager (FSM) capability is presently being used.

3. In order to overcome perceptions that clericals are not included in the decision making process, a clerical subcommittee was recommended to identify problems related to word processing, electronic mail and office equipment, and to provide guidance to the clerical staff. A major reorganization delayed establishment of this committee.

4. A contractor (General Software Corporation) was engaged to develop an inventory of directorate hardware and software and to make recommendations on the most cost effective way to automate and integrate our administrative systems (keeping in mind the Center and Agency plans). Initial thinking is that any system should include, at a minimum, integrated word processing, electronic mail and shared databases with local area networks as appropriate.

5. All members of the committee have implemented Telemail capabilities, and meeting announcements and minutes are now distributed by this method. We identified key personnel to use Telemail and arranged for training. Efforts in this area have led to the introduction of Telemail capability in the Directorate office. We are studying possible ways to implement electronic mail in many areas of intra-directorate communications.

The group has been on hold since January 1984, due to a major reorganization -- the merging of the two scientific directorates. This makes the need even greater to communicate through this forum and develop strategies for an overall direction for administrative automation and we anticipate starting up soon with additional members to represent the other directorate.

New management is already receptive and has added funds to include the second directorate in the Contractor's survey of equipment and software and an overall recommendation for a directorate strategy for administrative automation. Results will be presented this month.

FUTURE DIRECTIONS ANTICIPATED IN ADMINISTRATIVE AUTOMATION IN THE NEW SCIENTIFIC ENVIRONMENT

Most future plans for administrative automation within the Space and Earth Sciences Directorate involve the use of personal computers and applications that will distribute the processing among these smaller, lower price processors. The introduction of microcomputers to administrative data processing has brought about several changes in the way work is carried out and the way information is accessed, manipulated, shared, and transferred.

The way microcomputers have become a part of the administrative office follows a logical progression. The first management applications are typically spreadsheet modeling and local database manipulation. This usually involves entering the data manually into a model or data base. This first step introduces the user to the computer, and the capabilities.

Manual data entry is not efficient use of an administrator's time. This is especially true when the data already resides in some form on a larger computer system. So, the initial use for manipulating data leads to the desire for access to the data stored in mainframe computer data bases.

The micro-mainframe link is the first integration of microcomputers into the larger data processing picture. This step is followed by two more logical and semi-independent changes. In the past, the mainframe systems provided a central location for data storage and access. Microcomputer users do not have a central location to store this data and if data is going to be on these small computers, a suitable method must be found to transfer it from place to place.

This is where networking fits into future plans. As more data is distributed among decentralized locations, the need to share and transfer the data will require that networks be integrated into the work place. This is true in both the scientific and the administrative communities. The types and placement of such networks will depend on the specific needs of different users and the technology available. Local Area Network technology is developing rapidly. Still, there are a number of questions not yet answered in this area.

One relative certainty is Ethernet. Ethernet will probably provide the link within small areas, and multiple Ethernet segments will be the links within single buildings. The links between Ethernet segments, linking buildings over longer distances, is not yet certain. This is the area where the largest number of changes are still to come. Much research and product development is occurring now to find the best way to tie Ethernet segments together over these longer distances.

The use of microcomputers and local area networks provide capabilities that will be utilized in a variety of ways. The ability to draft papers, letters, and memos on a scientific or managerial work station and transfer via network to a clerical workstation for editing, formatting and quality printing will be utilized. Electronic mail will also become a standard for communications. It will never completely replace written mail, but it will become an accepted means of inter office communications.

Another important area in which microcomputers are just beginning to assert their capabilites is as a method of distributing the processing loads. These small inexpensive processors will help take some of the processing load off mainframe systems. Several vendors have introduced mini-mainframe powered desktop systems. The IBM XT370 with RAMIS II software may at some point provide a low cost local system capable of mainframe processing and compatible with the IBM 4341 based RAMIS II.

The use of microcomputers for the FY85 manpower exercise is another example of

distributed processing. Using low cost off-the-shelf software, an application was developed to utilize IBM Personal Computers. The application was developed to allow users to work on their manpower spreadsheet on the microcomputer. The spreadsheets were then collected from the divisions on diskettes, and uploaded into RAMIS directly. The application broke down to approximately 80% PC based processing and 20% mainframe based. This reduced the load on the host system, and provided both host and local system users an increased response time. This method was used for the first time in our newly combined directorates which is comprised of 752 Civil Servants and approximately 800 Contractors. Although this method was new to all users, feedback to date has all been positive.

An important factor to recognize in planning for microcomputer integration in the workplace is training. These systems are a great deal easier to use than a mainframe system. The application software is developed with non-computer personnel in mind. This does not mean that we can simply put the machine on a users desk and walk away. Along with the commitment of funding to purchase the computer, we must recognize the commitment necessary to train the user and make this investment worthwhile.

There are a few factors to note in this particular commitment. The first is that the staff requires training in the use of micro systems. Also, they should have access to training materials, and experienced personnel to help them utilize the equipment. Another factor to recognize is that while these systems may cost only a few thousand dollars, they provide the capabilities of much more expensive systems. They will also be utilized on similar applications as the larger systems. For these reasons, we should be aware that application development is an important part of maximum utilization.

Systems analysts can be as important in utilizing microcomputer systems as they are in utilizing mainframe systems. A manager can spend a lot of valuable time learning to use a microcomputer, time that is better spent managing actual applications. The administrative staff should be developing applications to assist the manager, providing managers the data they require, or developing the capability to access this data without investing a great deal of time learning sophisticated, complicated software.

We have set up an Administrative Data Processing room in our local area. This room has two microcomputers, three computer data terminals, a small software library, and staff to assist users in learning how to use the computers and the software, and to help set up applications. The cost of providing this assistance to the users is more than made up for in the savings in start up time for the staff. It also encourages users to find applications, since they are aware assistance is available. It helps them get over the initial uncertainty and fear (computer phobia) that many people experience the first time they use microcomputers.

SUMMARY

We've come a long way since 1981, but are really just beginning to scratch the surface. As automated systems improve, the layers of management between scientist and administrators will be reduced. Networking will create direct links between all levels of center personnel. Many improvements not forseen will come about as office systems develop.

Office automation will continue to change the way work is done for many years. Careful planning and commitment to integrating new systems with established methods will help facilitate these changes. The attitude that automation is done to improve a system, and not for the sake of automation is important. All levels of scientific and administrative staff will recognize improvements in a system and the success of each effort to automate will facilitate the next effort. Automation must be recognized as a process that occurs over time.

It will take full commitment from all levels of management for resources and funding, on-going training and continued group efforts, greater interaction with the scientific community and willingness to share resources and technology if we hope to come close to accomplishing major administrative achievements and productivity increases through automation that are taken for granted in the scientific and technical areas.

Finally, an assessment of administration automation in this scientific environment in 1984. We certainly have not obtained the "paperless office" as were the "buzz" words of 1980, and we're still striving for the "office of the future." However, the accomplishments during this period: reduction of paperwork and manual efforts; improved communications through telemail and committees; additional support staff; increased awareness at all levels on ergonomic concerns and the need for training; better equipment; improved ADP skills through experience; management commitment and an overall strategy for automating, gives us an excellent base to meet the upcoming challenges in managing resources in the largest directorate at Goddard.

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THE ADMINISTRATIVE WINDOW INTO THE INTEGRATED DBMS

Georgia H. Brock
John F. Kennedy Space Center

I. Introduction

In parallel to the evolution of Management Information Systems from simple data files to complex data bases, the stand-alone computer systems have been migrating toward fully integrated systems serving the work force. The next major productivity gain may very well be to make these highly sophisticated working level Data Base Management Systems (DBMS) serve all levels of management with reports of varying levels of detail. Most attempts by the DBMS development organization to provide useful information to management seem to bog down in the quagmire of competing working level requirements. Most large DBMS development organizations possess three to five year backlogs. Perhaps Office Automation is the vehicle that brings to pass the Management Information System that really serves management. A good office automation system manned by a team of facilitators seeking opportunities to serve end-users could go a long way toward defining a DBMS that serves management.

This paper will briefly discuss the problems of the DBMS organization, alternative approaches to solving some of the major problems, a debate about problems that may have no solution, and finally how office automation fits into the development of the Manager's Management Information System.

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II. What is Office Automation?

Office automation has many facets, but the rise in administrative costs has forced industry to seek more aggressive ways of increasing administrative productivity just as has been done for decades on the assembly line. Of course, office work is not a well defined integrated process with measurable raw material and countable units of output. Therefore, the office productivity axiom assumes that if each office task can be completed faster and with more accurate information, then the composite of all the tasks will result in greater overall productivity. Even harder to measure are the real benefits such as increased profitability or reduced or avoided expenses. At NASA, we measure productivity in terms of more work done by fewer people, but the amount of work is hard to measure. Increasing launch rates are measurable, but the work involved in new space station challenges is hard to compute or even estimate. Even so, it seems logical to assume that an integrated office environment will produce efficiencies similar to the integrated assembly line. The task of automating the office in itself has potential for increasing efficiency, but every facet must be carefully considered to obtain maximum benefit without disruption and to create an atmosphere conducive to the process of favorable change. Since organizations and people tend to resist changes that create confusion and chaos in the work place, a highly structured evolutionary process must be projected. Figure 1 depicts the many facets of office automation that must harmonize for the benefit of the organization through increased productivity. Figure 2 focuses on the office automation environment, Figure 3 lists the office automation components, and Figure 4 depicts the office automation relationship to the total management information system.

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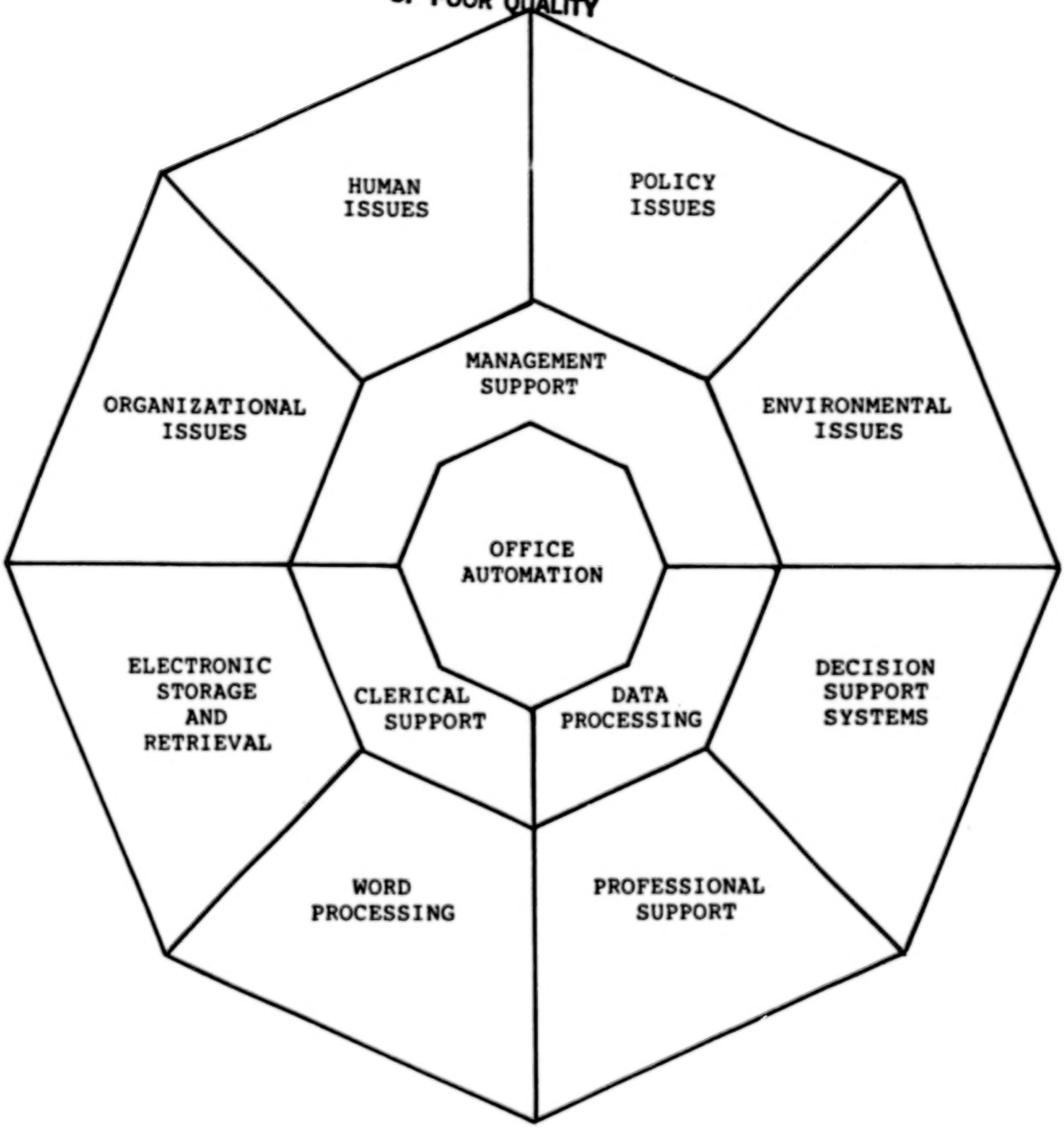
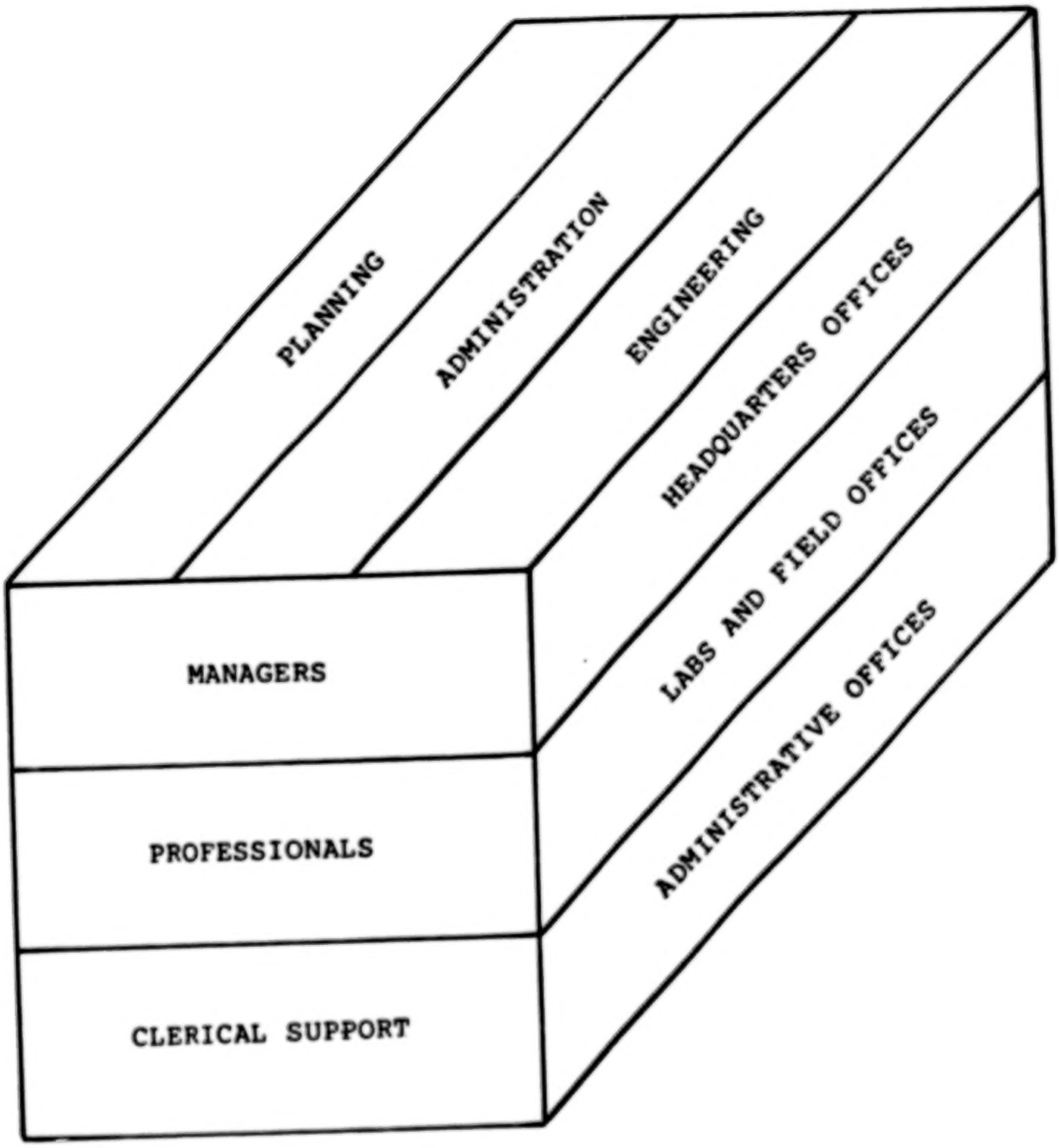


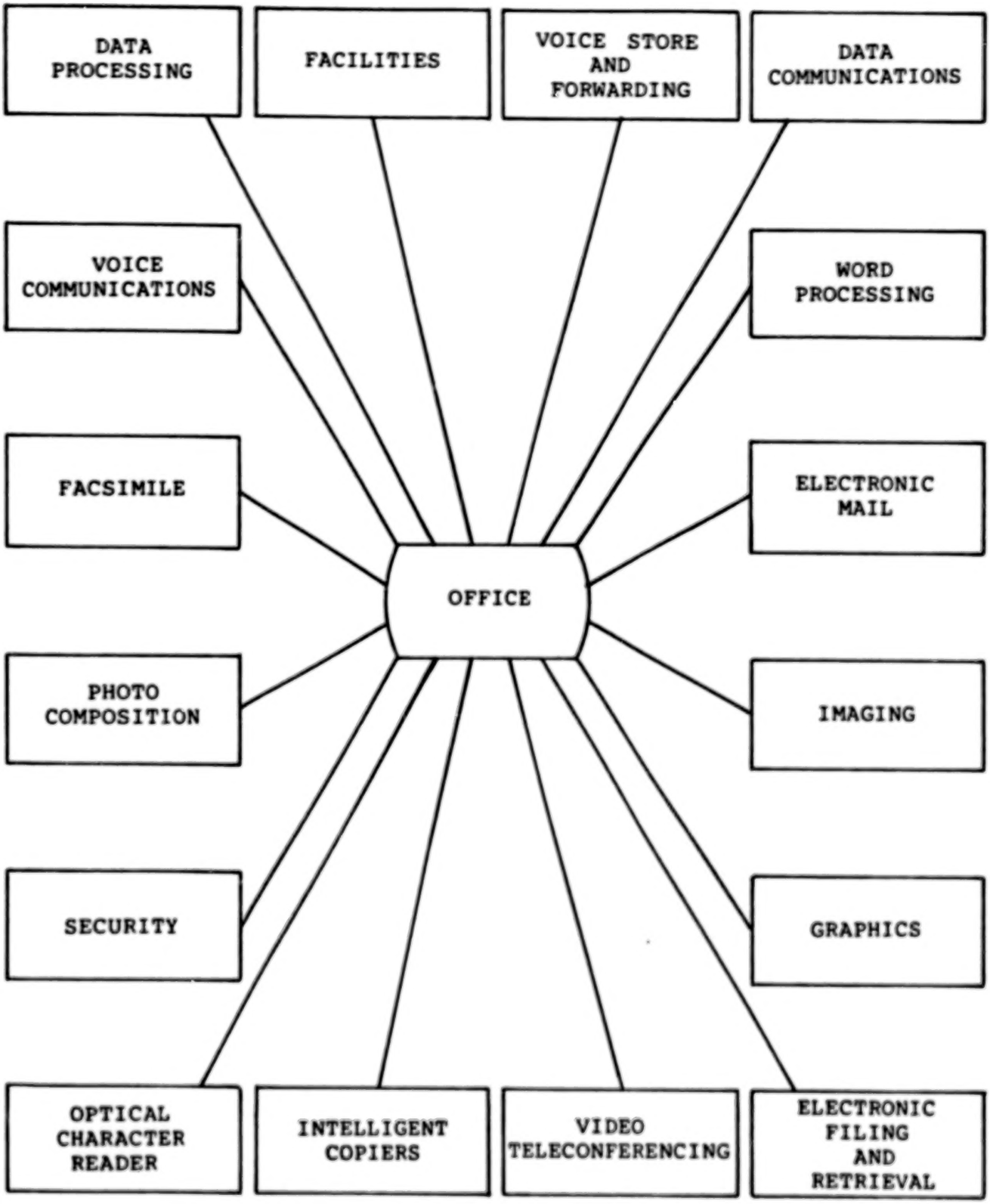
OFFICE AUTOMATION INTEGRATION FACTORS

FIGURE 1



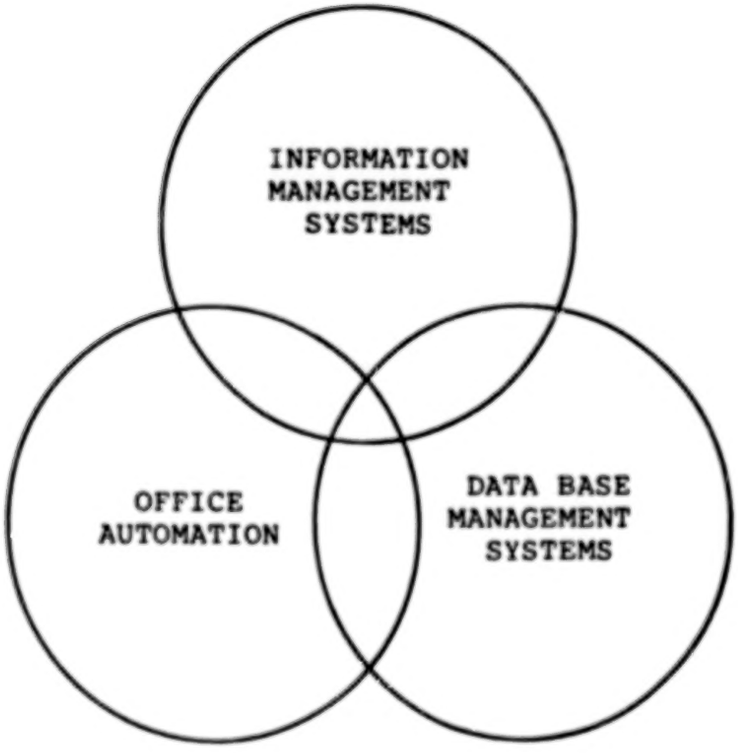
OFFICE AUTOMATION STRUCTURE

FIGURE 2



COMPONENTS OF OFFICE AUTOMATION

FIGURE 3



INTEGRATED INFORMATION SYSTEMS

FIGURE 4

III. Office Automation and the Large Integrated Data Base Management System (DBMS)

A. The Dynamic Evolution of the Large DBMS

It is well known that even the first computers performed simple repetitive tasks effectively. Any process that must be done over and over by the same identical method is a great candidate for computerization. Equally important is the computer's efficient storage and recall of data. Once stored, information can be retrieved, sorted, and reported to highlight important trends that would have been lost in most manual systems. In the simplified model depicted in Figure 5, processing the data can be a complicated mathematical model or a simple procedure that manages data to support an organization performing a job. The computerized mathematical algorithm is rather easy to imagine, but the simple procedure in support of a job can be clarified by example. For instance, the job of performing maintenance on computer hardware seems routine enough for our model of a simple procedure. Figure 6 defines the procedure. The basic information of problem report number, work order number, description, and identification of the hardware component or part provides a history of work performed. Adding dates to the actions provides performance information for the maintenance technician's supervisor and identifies resolved problems and design changes for operations and design personnel. If the organization is relatively large and there are many computers operating in similar configurations, (e.g., the consoles supporting Shuttle vehicle subsystems in KSC's firing rooms), then the technician must be identified and the location of the hardware established. The operations personnel want timely data, so the simple computerized procedure becomes the on-line "Automated Line Replaceable Unit Tracking System." It now keeps track of the location of all spare parts, parts sent to the vendor for repair and expected due dates, etc., etc., etc. It automatically flags the on-line "Problem Reporting and Corrective Action System" when problem reports are closed. It automatically flags the on-line "Configuration Management Data System" when design changes are complete. It automatically flags the "Shuttle Inventory Management System" when the stock of spare computer parts is low. It interfaces with the "Automated Ground Operations Scheduling System" to schedule the work and the needed resources. Two of the systems that are notified of significant events are not on the same computer. The simple procedure has quickly grown into a sophisticated integrated networked system of DBMS's that keep track of hundreds of pieces of information that are entered by people in different NASA

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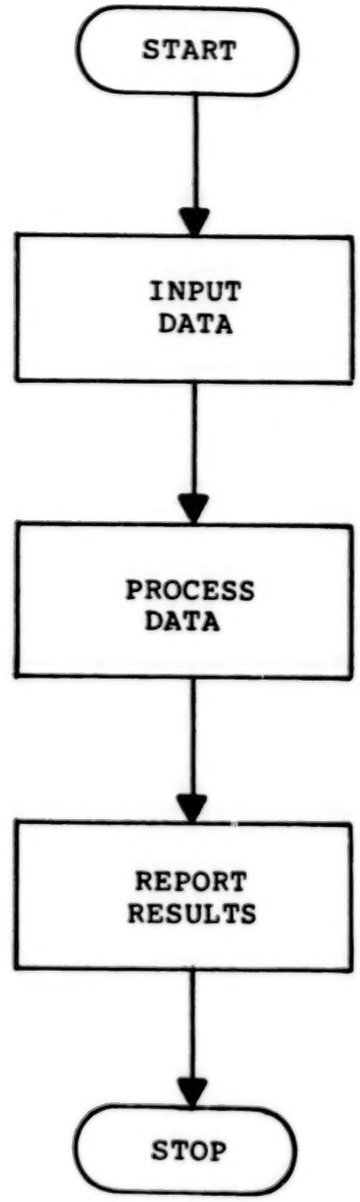
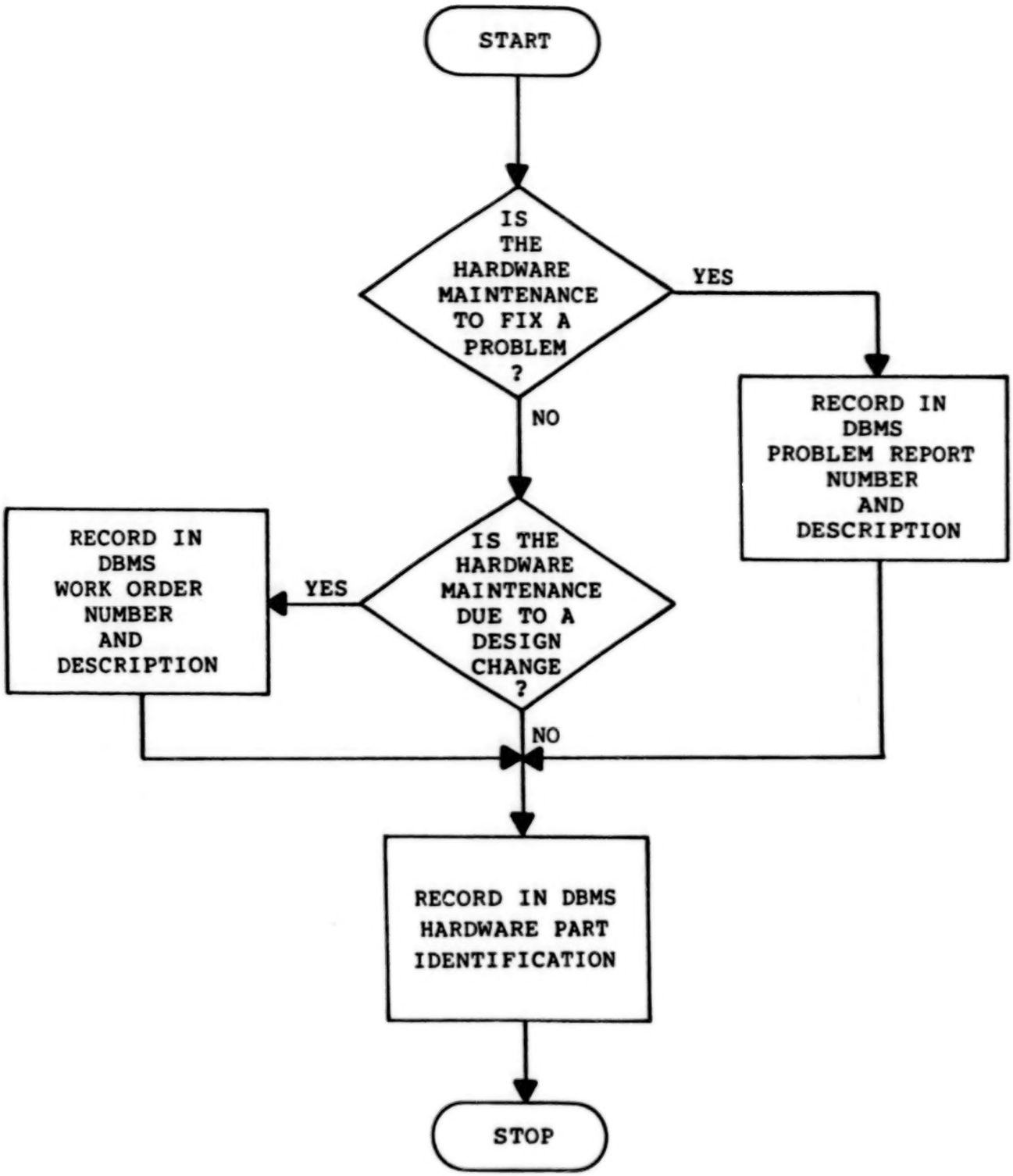
[1] The systems identified in this section are not totally integrated at this time, although long range plans incorporate this approach.



DATA PROCESSING MODEL

FIGURE 5


START
IS THE HARDWARE MAINTENANCE TO FIX A PROBLEM ?
YES
NO
RECORD IN DBMS PROBLEM REPORT NUMBER AND DESCRIPTION
IS THE HARDWARE MAINTENANCE DUE TO A DESIGN CHANGE ?
YES
RECORD IN DBMS WORK ORDER NUMBER AND DESCRIPTION
NO
RECORD IN DBMS HARDWARE PART IDENTIFICATION
STOP

COMPUTER MAINTENANCE MODEL

FIGURE 6

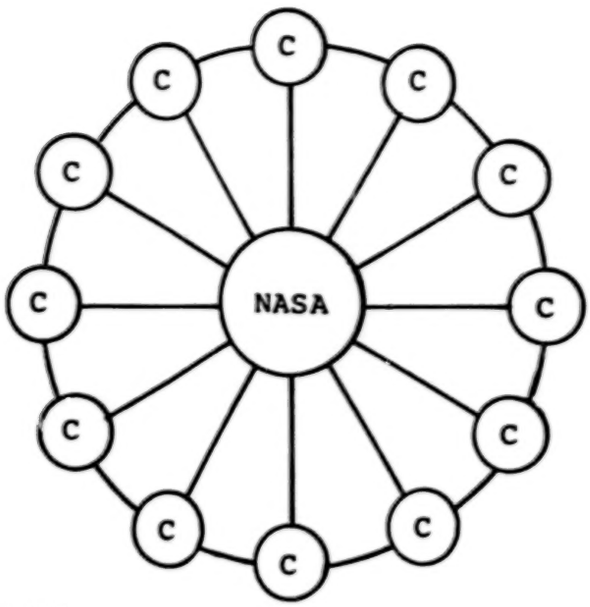
and contractor organizations and are protected by elaborate security procedures that ensure autonomy for the authorized organization. Since these computer programs essentially follow the flow of procedures defined to perform work, they are directly affected by each change to the procedure. Even adding volume with no logical change can affect the computer programs. The complicated mathematical model is beginning to look simple and the simple procedure is beginning to look complicated.

B. The Problems That Resist Solutions

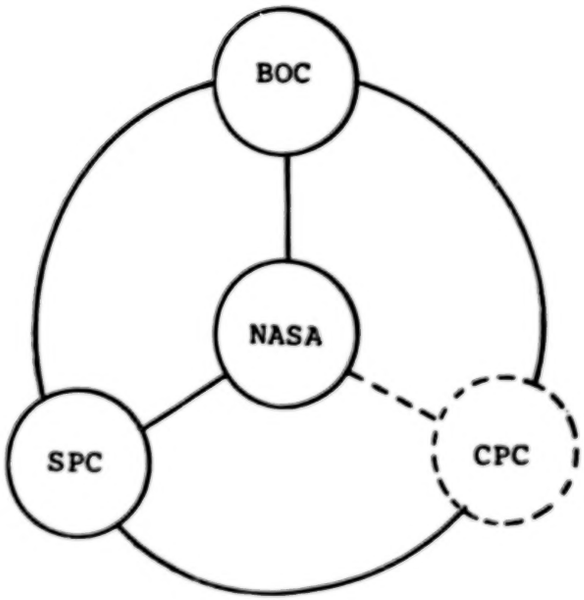
What is the simple solution to large DBMS that cannot keep up with the dynamic nature of work flow procedures? Can we make the work flow procedures less dynamic? Can we increase the computer resources to accomplish more timely modifications? Both approaches are valid but are not simple or easy in a large organization.

Let's examine the approach that controls the dynamic nature of work flow procedures. KSC has just accomplished a major milestone along this path by combining a large number of small contracts into two large contracts for the base operations and the Shuttle processing. A possible third large contract may handle cargo processing. Our model of computer maintenance in the firing rooms involves the first two major contractors. Just as the spokes in Figure 7 are reduced, the work flow procedures are diminished by no longer needing to separate each contractor's part of the job. When responsibilities are concentrated from five or six contractors to one contractor, the computer program becomes simpler. However, it must be changed. Along with the scramble to consolidate, KSC must seize the opportunity to streamline the operation. It seems that we may have so many changes to the procedure that the computer programs may need a major rewrite. In our quest for stable work flow procedures, we have generated a major seismic tremor that will send shock waves through the computer systems for some time. However, as with ground faults seeking equilibrium, a more stable future computer base is the eventual derivative.

The second approach that attempts to pour more resources into the computer department so that modifications can be made quicker and easier, can certainly reduce the backlogs. However, a number of practical issues limit a total solution by using this approach. Buying major upgrades to computer systems is a very time consuming task due partly to the government procurement regulations. Increasing the staff is sometimes even harder due to the shortage of computer personnel. These two constraints prevent sizing the resources to equal the task. As Figure 8 shows, the limited resources applied to the requested modifications tends to flatten the need date



C=CONTRACTOR



BOC=BASE OPERATIONS CONTRACTOR
SPC=SHUTTLE PROCESSING CONTRACTOR
CPC=CAPGO PROCESSING CONTRACTOR

INTERFACES TO THE NASA CONTRACTORS

FIGURE 7

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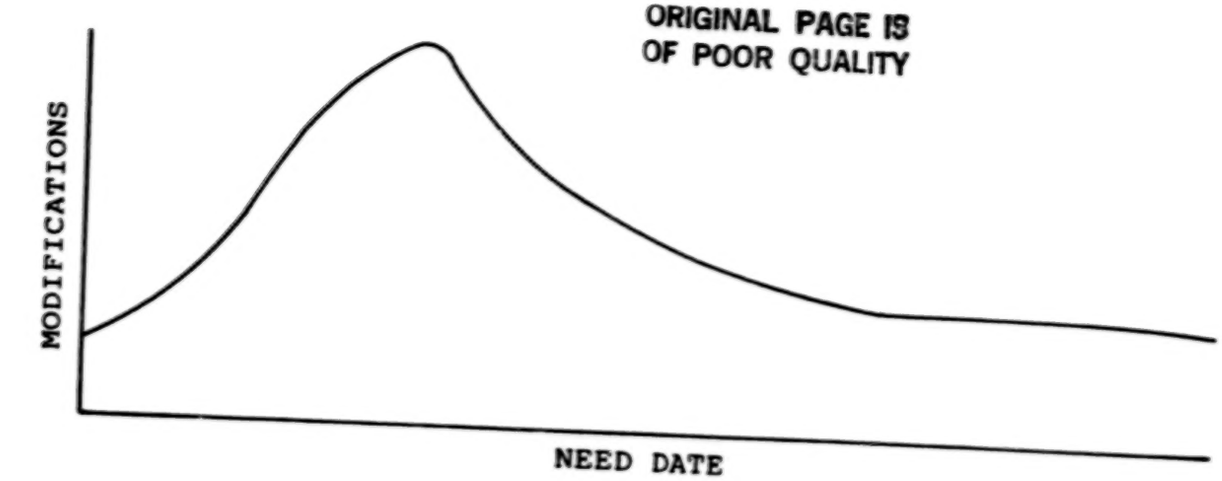
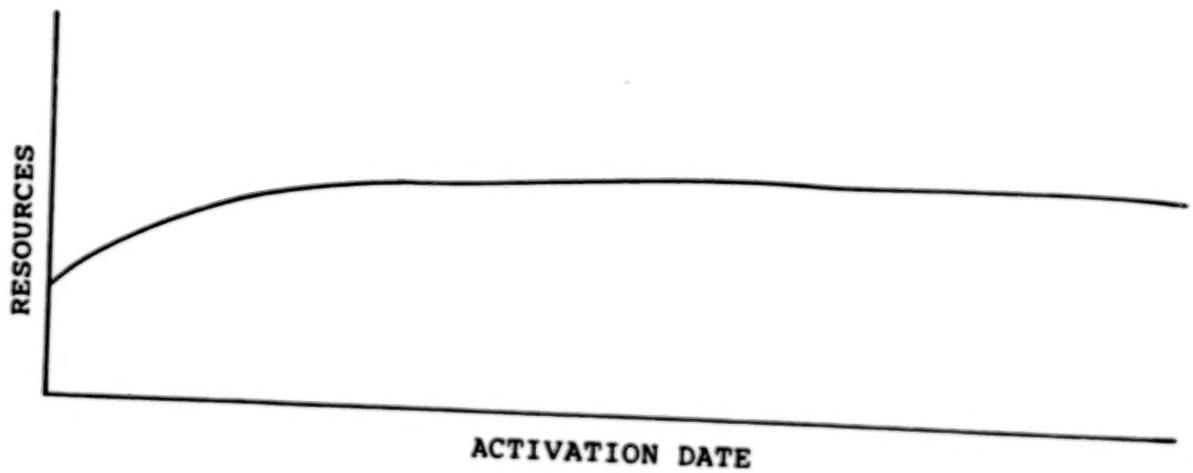
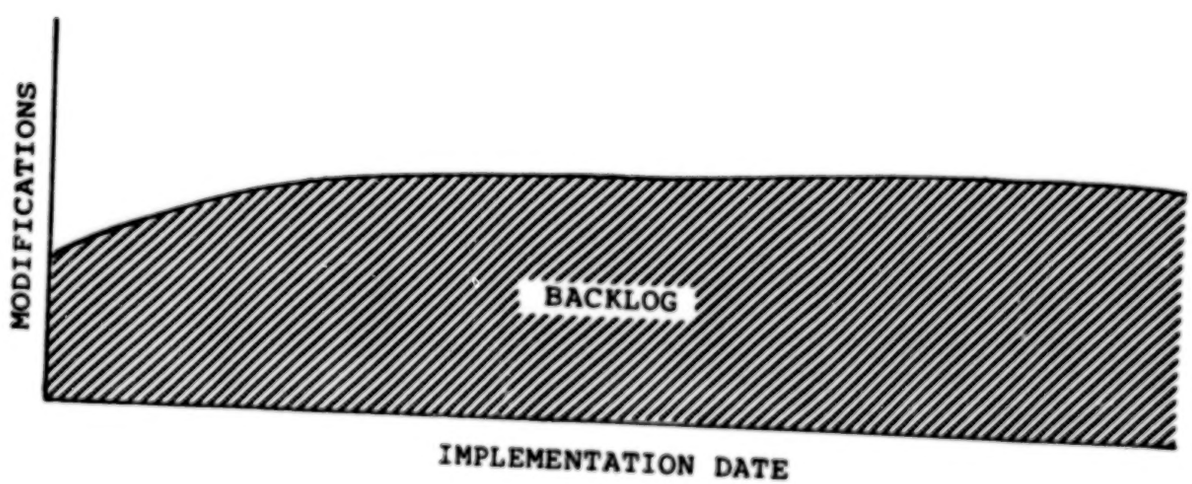






MODIFICATIONS > RESOURCES=BACKLOGS

FIGURE 8

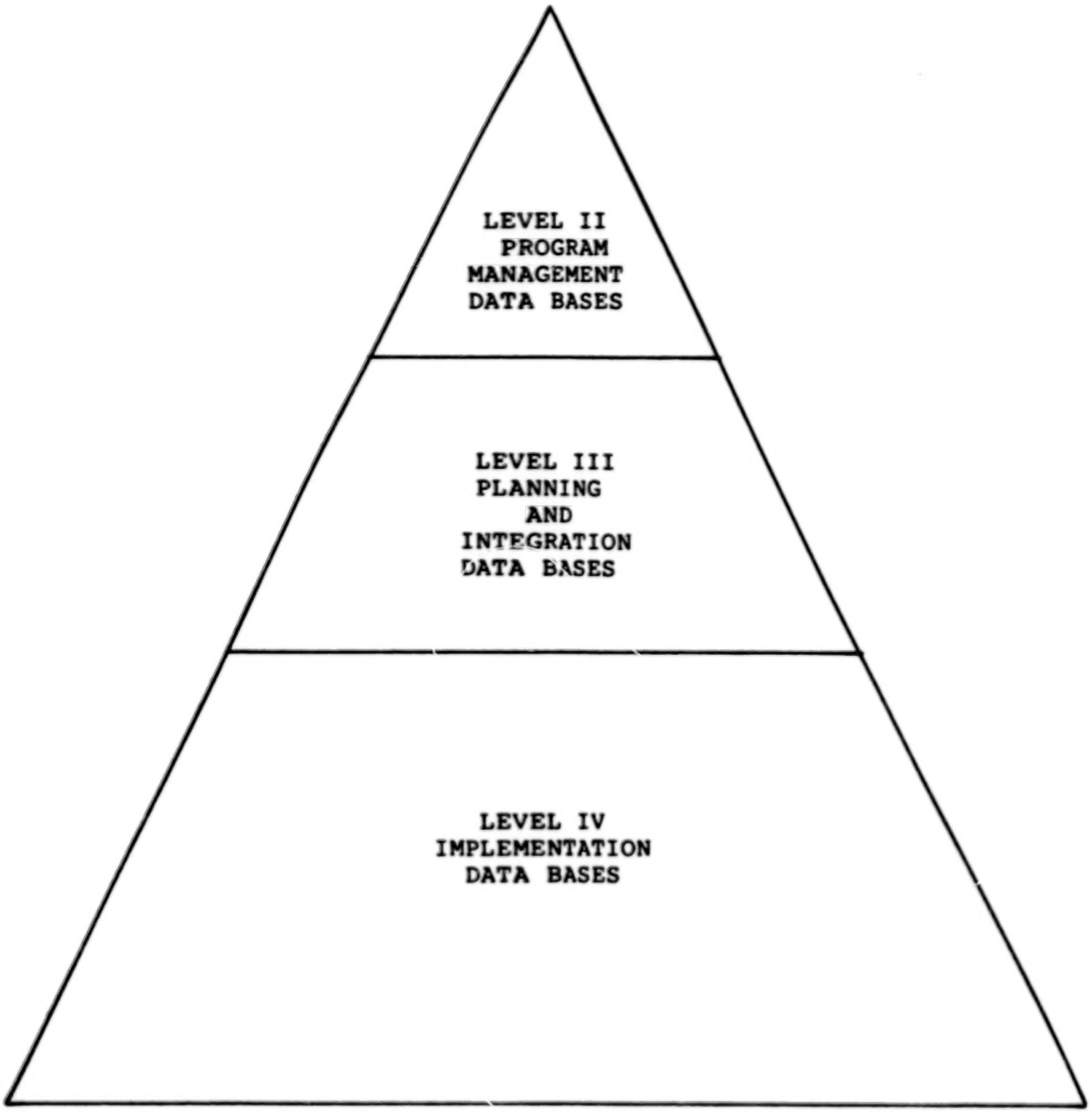
curve into an implementation curve that closely resembles the activations of resources curve. Almost all of the requested modifications become backlogged items.

C. Where Are the Priorities - Where Should They Be?

The computer systems that have been described are Level IV work procedures. Information from these data bases feed computerized systems at Level III (e.g., Artermis schedules) and Level II (e.g., "Inter-Center Problem Reporting and Corrective Action"). Figure 9 describes the Level II, III, and IV relationships. When the computer systems are down, the ability to get the job done is impacted at all levels. When the requested modifications are backlogged, the jobs take longer to perform. Impact to the computerized procedure directly affects the productivity of the work force at each level. The dreaded impact to workforce productivity tends to place a priority on modifications that benefit the work force rather than the modifications that benefit the managers. The reports generated from the data bases provide data to the people who do the work. Reports designed to identify trends that would be useful in making management decisions are not prevalent. Normally, professional and technical people provide management with oral and written reports that summarize progress or identify problems or issues. The data bases that support the work force could also provide valuable information. Unfortunately, these reports in their current state are usually bulky and hard to interpret. Sometimes the information is scattered across systems and computers and is very difficult to integrate. On top of all of these problems, they must be mailed or hand carried. Often the information is badly dated by the time it hits the mail drop.

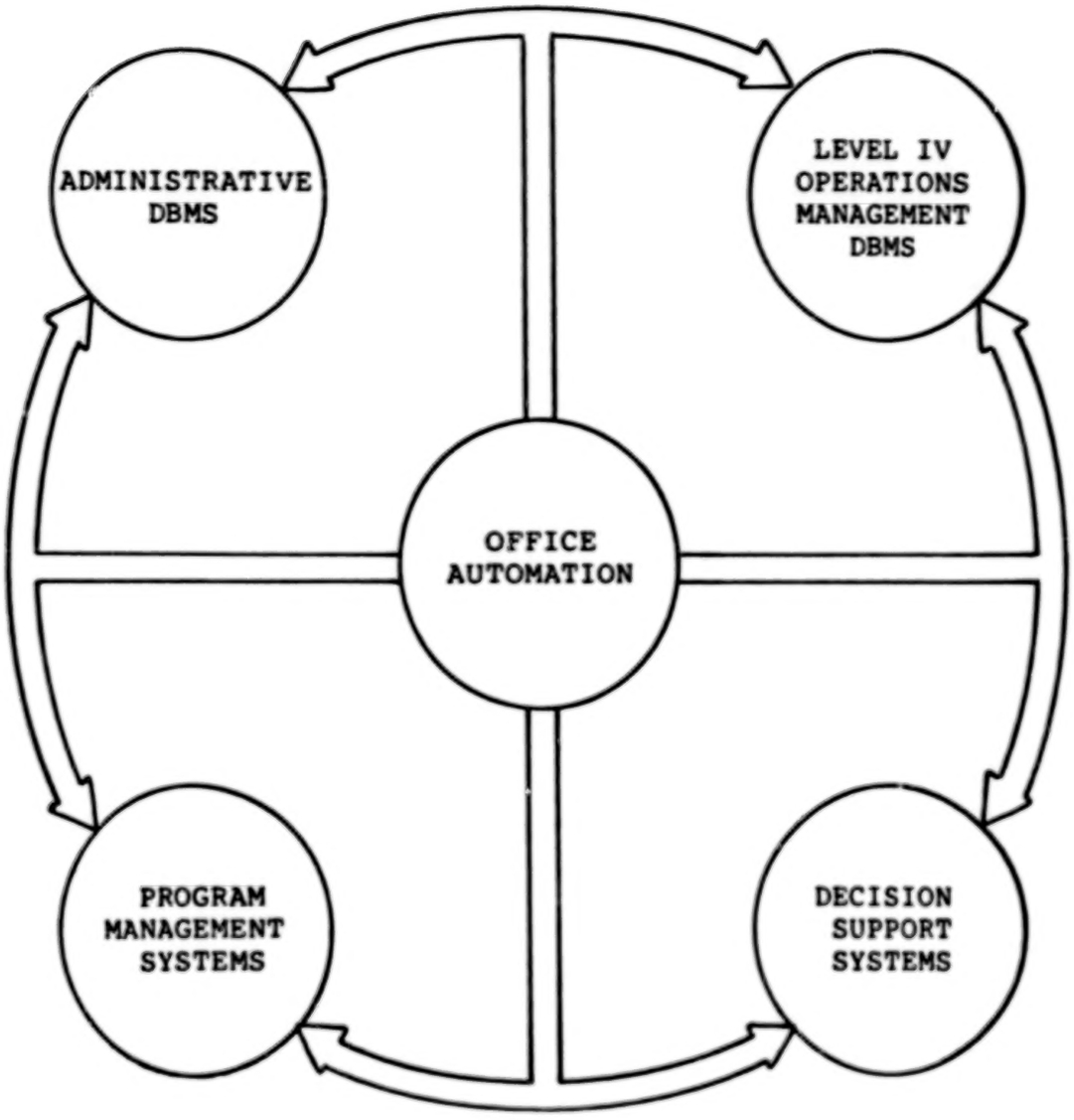
D. The Office Automation Alternative

Office automation may be the answer to the modification bottleneck and the awkward management reporting system. If managers or their executive staffs had access to personal computers equipped with software tools to manipulate data, and these tools were networked to the large DBMS, then reports could be tailored to the individual manager and delivered electronically to the local office printer. As the staff becomes more familiar with the information in the DBMS and learns more about the power of the tools available through the personal computer, ad hoc reports designed by the staff can generate timely responses to immediate requirements for information. By expanding the hardware and software tools, both managers and workers can tap the information to suit their needs without impacting one another. Figure 10 depicts this expanded system.



INTEGRATED SHUTTLE PROCESSING DBMS

FIGURE 9



NETWORKED OFFICE AUTOMATION SYSTEM

FIGURE 10

IV. The Office Automation Solution

A. Two Obstacles That Can Be Eliminated

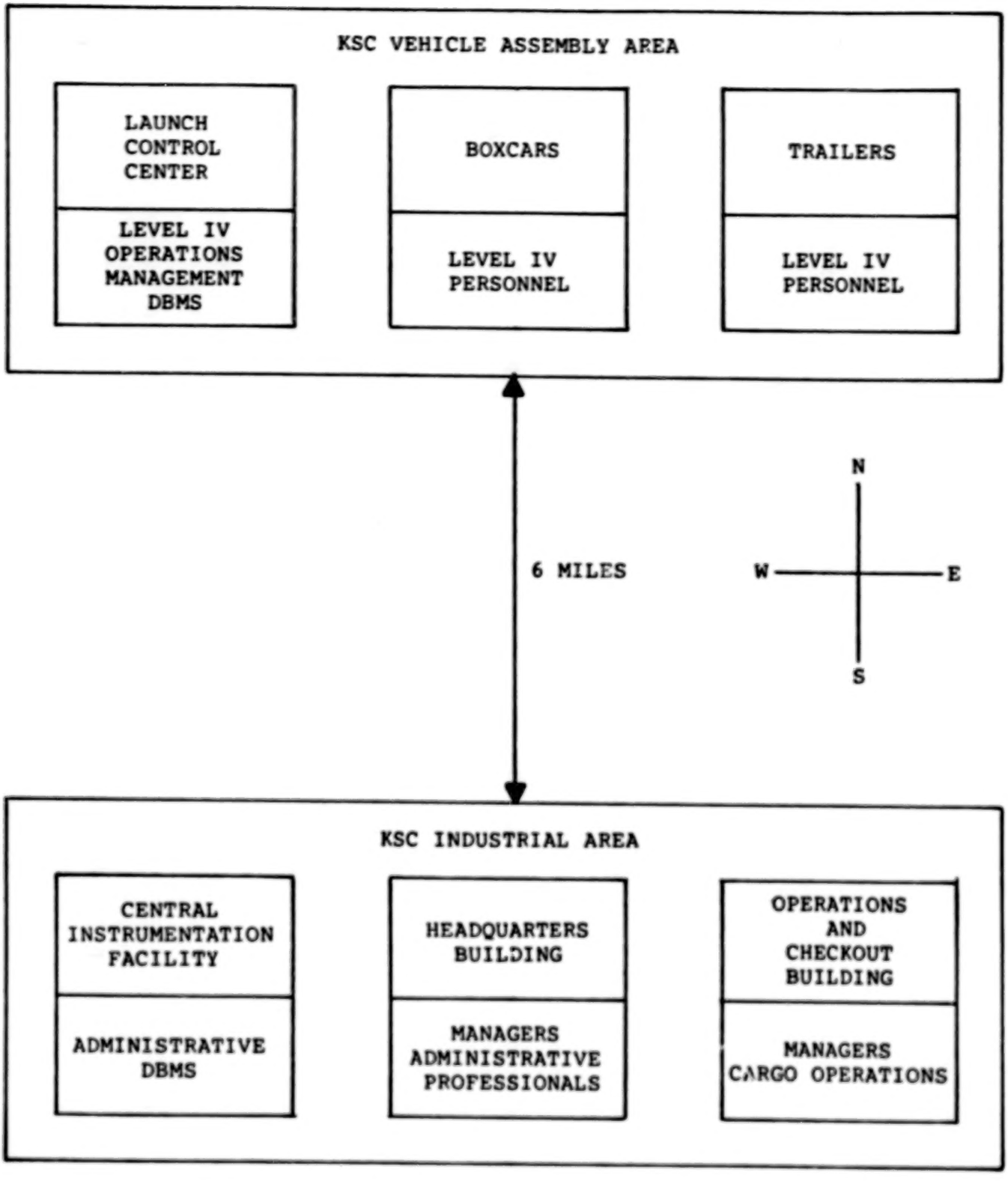
In order to be effective, two major problems outside the office automation system must be solved. First, the various mainframes that host the large DBMS are either currently overloaded or operating marginally during periods of peak utilization. If office automation demands are to be met, then long range mainframe utilization patterns need to be studied and adjusted to accommodate the traffic. The office automation system could provide central hardware that would relieve a portion of the loads on the mainframes. The second major problem that needs a solution is the outmoded KSC communication plant. NASA and contractor personnel are concentrated in two major areas as defined in Figure 11. The Kennedy Switched Data Network (KSDN) that is currently in procurement will provide the communications backbone between the major buildings and population centers. This system is basically a multiplexed twisted pair solution that will maximize the utilization of the existing cable plant. It will serve the communications requirements until growth pushes the center toward a fiber optics replacement. Local area networks within major buildings as part of the office automation system would solve some of the inflexibleness of the KSDN's twisted pair solution. The current 45 day lead time required to attach end user equipment to a twisted pair cable plant could be eliminated by providing local area network outlets in each room. The local area networks within buildings and the KSDN between buildings should network end users to any destination desired.

B. The Goals of Office Automation

There are a number of committees throughout NASA devoting their time toward achieving increased productivity through improved management information systems. KSC's Office Automation Task Team chaired by Dallas Gillespie was formed in March 1983. Figures 12 and 13, from the February 1984, Booz, Allen and Hamilton "NASA Office Automation Planning Study Findings and Conclusions," identifies the NASA Goals and the NASA-wide information system steering groups. Office automation assists in the achievement of all of these objectives.

On the local level, KSC must improve the effectiveness of NASA personnel in order to meet the increasing demands of the Shuttle multi-vehicle processing, Space Station planning, Shuttle/Centaur modifications, and various new support requirements. An integrated office automation system provides for increased productivity through the following general objectives:

- Provides more timely and integrated information access.



MAJOR POPULATION CENTERS AT KSC

FIGURE 11

NASA GOALS

Presented By James Beggs on March 23, 1983

- PROVIDE FOR OUR PEOPLE A CREATIVE ENVIRONMENT AND THE BEST OF FACILITIES, SUPPORT SERVICES, AND MANAGEMENT SUPPORT SO THEY CAN PERFORM WITH EXCELLENCE NASA'S RESEARCH, DEVELOPMENT, MISSION, AND OPERATIONAL RESPONSIBILITIES.
- MAKE THE SPACE TRANSPORTATION SYSTEM FULLY OPERATIONAL AND COST EFFECTIVE IN PROVIDING ROUTINE ACCESS TO SPACE FOR DOMESTIC AND FOREIGN, COMMERCIAL, AND GOVERNMENTAL USERS.
- ESTABLISH A PERMANENT MANNED PRESENCE IN SPACE TO EXPAND THE EXPLORATION AND USE OF SPACE FOR ACTIVITIES WHICH ENHANCE THE SECURITY AND WELFARE OF MANKIND.
- CONDUCT AN EFFECTIVE AND PRODUCTIVE AERONAUTICS PROGRAM THAT CONTRIBUTES MATERIALLY TO THE ENDURING PREEMINENCE OF U.S. CIVIL AND MILITARY AVIATION.
- CONDUCT AN EFFECTIVE AND PRODUCTIVE SPACE SCIENCE PROGRAM WHICH EXPANDS HUMAN KNOWLEDGE OF THE EARTH, ITS ENVIRONMENT, THE SOLAR SYSTEM, AND THE UNIVERSE.
- CONDUCT EFFECTIVE AND PRODUCTIVE SPACE APPLICATIONS AND TECHNOLOGY PROGRAMS WHICH CONTRIBUTE MATERIALLY TOWARD U.S. LEADERSHIP AND SECURITY.
- EXPAND OPPORTUNITIES FOR U.S. PRIVATE SECTOR INVESTMENT AND INVOLVEMENT IN CIVIL SPACE AND SPACE-RELATED ACTIVITIES.
- ESTABLISH NASA AS A LEADER IN THE DEVELOPMENT AND APPLICATION OF ADVANCED TECHNOLOGY AND MANAGEMENT PRACTICES WHICH CONTRIBUTE TO SIGNIFICANT INCREASES IN BOTH AGENCY AND NATIONAL PRODUCTIVITY.

Figure 12

NASA-WIDE INFORMATION SYSTEM STEERING GROUPS

Group	Function
OASG - Office Automation Steering Group	Coordinates and promotes the planning and integration of automated technologies with Headquarters and NASA-wide program activities. The OASG has members from Institutional Program Offices, EIS, and PTMC.
EIS - Electronic Information Services Working Group	Exchanges information for office automation between centers and Headquarters.
PITAC - Planning and Implementation Team for Administrative Computing	Coordinates the development and implementation of Agency-wide Administrative ADP Systems. Membership includes representatives of all center Administrative ADP Managers plus Headquarters ADP Planning, Management, and Resource Management Groups.
AIMS - Action Information Management System Committee	Coordinates establishment of office automation pilots involving headquarters program offices and selected center groups. The pilots are intended to define program support office automation application requirements and specifications.
INC - Intercenter Network Committee	Establishes guidelines and procedures to ensure end-to-end interoperability and security of "non-NASCommunication Networks." This includes coordinating center plans for Program Support Communication Network gateways.
SOAP TEAM - Strategic Office Automation Planning Team	Coordinates the development of an Agency-wide Office Automation plan and OA technology utilization coordination activity.

BAH, Feb. 1984

Figure 13

- Improves communications between workers.
- Implements a wide range of cost effective office automation technologies and applications.
- Facilitates decision making.

C. KSC's Approach to Office Automation

KSC's approach toward achieving an integrated office automation system has been to focus the activity through the Office Automation Task Team (OATT) which is directed by an Oversight Committee and the KSC Center Director. Since inception in March 1983, the OATT has conducted site visits of installed systems, reviewed the literature, canvassed the KSC community, consolidated the requirements, and defined the specifications. These specifications have been issued to industry and the NASA community for review and comment. The responses have been evaluated and the committee is currently preparing a report for the Oversight Committee and the Center Director.

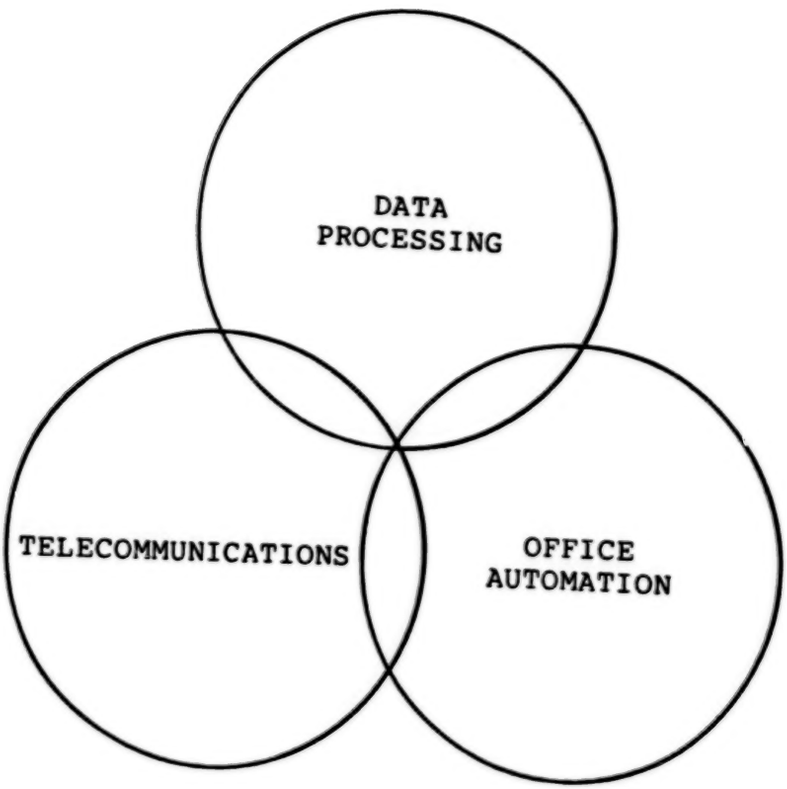
Practical experience with networked office automation systems has been obtained through a leased pilot that is networked as well as connected to a system of data phones in key management areas. A personal computer loan pool has been established to promote the use of automated techniques. As with most government and non-government organizations, KSC has previously spent its office automation dollars on word processors for the office support personnel. Now that communications networking for stand alone units is becoming more available, the future targets for increased productivity are the managers and professionals who account for 80% of the total office personnel costs. While stand alone personal computers can increase the productivity of this group to some extent, the timely integrated reports from the large DBMS will provide a major portion of their decision support system.

Without listing every office automation technology that KSC expects to get, there have been a number of features that have been identified as critical to system acceptance by the KSC community. The office automation system must have a graphics package suitable for generating viewgraphs of moderate complexity, must have an integrated approach to the office systems functions, must be user friendly and responsive, must have a powerful electronic mail and filing system, and must have a comprehensive data base manager and communications capability. A major goal is to provide the networking functionality to our contractor's office automation systems. Adequate training is viewed as a major key to user acceptance and system success.

D. Office Automation Expectations

Integrated information (Figure 14) serving all levels of the work force and management is KSC's expectation. Planning and reporting are expected to shift from "anticipatory" to "on demand." Planning will shift from analysis to simulation. Reporting will shift from historical trend projections to real time control. Information will become more accurate, more detailed, and more available. People at all levels will become more productive.

On the other hand, the management of expectations is a critical success factor for office automation. How fast can new technologies be absorbed without disrupting the work force. Technology is a moving target - there will always be more tomorrow. There is a critical need to promote the acceptance of lags between the creation of technology and its implementation and lag between commercial availability of technology and meaningful user absorption. The KSC implementation plan seeks to avoid disruption, protect investments, secure acceptance, justify costs, provide functionality, and prevent obsolescence. Office automation is a process rather than a project. The office automation user for the first time will have the opportunity to solve the cumbersome manual procedure through automated methods. As the work force experiments with the tools that are available through office automation, they, the end user, will invent the office of the future through the natural selection of the useful features.



INTEGRATED INFORMATION

FIGURE 14

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A User View of Office Automation or The Integrated Workstation

by
E.R. Schmerling

Abstract

Although handling information is a major part of our work, the information we need generally exists in many different places and even different forms. This makes it difficult and inefficient to search for the needed information, to verify that it is correct (or the latest version), to incorporate it in our work, and to transmit it to its recipient. Electronic technology can greatly ease the solution of these problems, and can help free us from the paper chase.

The importance of central databases will be discussed. These are only useful if they are kept up to date and easily accessible in an interactive (query) mode rather than in "monthly reports" that may be out of date and have to be searched by hand. The concepts of automatic data capture, database management and query languages will be introduced. These concepts, however, still need good communications and readily available work stations to be useful. It will be shown that a "personal computer" is the minimal necessary work station. These will rapidly become as ubiquitous as the telephone, and will provide easy access to databases, other users, larger computers and most office tools. This will lead naturally to vastly improved information flow and the reduction of "grunt labor". It will be shown how these concepts are equally valid for administrative, secretarial and scientific work.

1. The Paper Office

Our offices are still run by paper: paper for communications, paper for work-orders and purchases, and paper for computations. Despite the increasing use of computers, they are still, to a large extent, ***centrally inaccessible***. Now that terminals and small (personal) computers are readily available, the time has come to grow out of the "central computer printout" mentality and make increasing use of the on-line distributed capabilities that have become a technical reality. The central computers have become a fact of life; in conjunction with the Personal Computer (PC) they can become a real asset.

Using computers for communications reduces time, reduces transcription errors and makes computers **directly available to users** instead of going through the intermediaries generally associated with central computer facilities.

2. Central Data Bases

It is valuable to any large organization to have a central information pool consisting of the state of its business, its finances, inventories, etc. Nowadays these are increasingly being kept in computer memories, and dignified by the appelation of *Data Bases*. The problems we face are how the data are to be entered, how they may be retrieved, and how they may be kept up to date. It is clear that collecting pieces of paper for transmittal to key-punch operators is inefficient; it guarantees time delays and transcription errors. Equally, the perusal of monthly reports represents a poor way of retrieving information required to answer specific questions.

3. Data Capture

Data should be entered into the computer as close to the source as possible. There is no *technical* reason why financial data, purchase orders, manpower utilization reports, etc., should not be entered on a keyboard rather than a typewriter. The information can always be printed out in any form desired, or sent to its destination electronically. Some form of automatic data capture is needed to ensure that the computer databases are accurate and up to date, in addition to the obvious saving of several steps in the current procedures. An approval chain can also be set up by computer, so that the information is only passed on when the appropriate person signifies his assent. Editing, or making changes, is equally easy to do provided that the requisite procedures are set up, and the privileges to read and write are judiciously allocated.

4. Data Retrieval

Retrieval should be immediate and on-line. This implies that the data be stored in an orderly way under control of a decent query language. The computer's fingers should do the walking, and the user should be able to go directly to the data needed with a minimum of effort and computer jargon. Great strides are being made in relational database systems that come close to meeting real requirements in this regard and require a minimum of time to learn. This is where a personal computer is very useful; it can originate the query to a much larger system, receive a selection of data for further manipulation, and print out at the user's desk an edited summary of the answers to his questions for further action. While the completely paperless office will undoubtedly remain a pipe dream for the foreseeable future, there is no question that a great reduction can be made in the useless and outdated information that presently clutters up our workplaces.

5. Editing and text work

The personal computer has the advantage over special purpose word processors that it is far more flexible. A wide variety of word processing programs is available, and many of these can also be tailored to the individual, whereas dedicated word processors are immutable. A user can select a very simple text formatter like TEXTRA, progress to more powerful systems like VOLKSWRITER DE LUXE, or the Wang-like MULTIMATE or even the clumsy but powerful WORDSTAR. Programs like SAMNA WORD can format multi-column text, do arithmetic and generate automatic tables of contents, WORDIX will hyphenate automatically. The choice is very wide, and the better programs can merge material taken from central or other databases via communications links. The PC can also format material for the very powerful programs like TEX that have several hundred fonts and mathematical symbols not available on *any* word processor with a mechanical printer.

6. Communications

Computer mail is much more convenient than US mail and much better than playing telephone tag. Received via a PC, it can quickly be turned into hard copy if desired, or forwarded to other users. An interesting use is for multi-authored manuscripts, which can be bounced back and forth many times in short order until all the authors reach agreement.

7. Computing

A modern PC is, in itself, a surprisingly powerful computing tool, better than the machines available in most University math labs thirty years ago. However, it is clearly not the equal of larger machines. With a PC linked on a network, however, a user should be able to call on a machine appropriate to his problem.

8. Graphics

A PC like the IBM-PC can generate charts and low resolution graphics suitable for many purposes. The Apple Macintosh and Lisa are better in this regard, and can easily produce a variety of graphic material. For some purposes these are not of sufficient resolution, and lack the more sophisticated capabilities required in a full-featured graphics shop. Very powerful workstations have been built that include such capabilities. Notable is the IRIS where quite complicated objects like the Space Shuttle can be represented in some detail, and individual portions rotated to examine clearances, sun illumination and the relative positions of portions of the payload with respect to the earth, sun and stars.

Sophisticated programs for generating directly almost any conceivable color graphics that can be produced by a well-equipped graphics department are now available on mini-computers. These can be generated directly from a terminal, or a PC used as a terminal, and manipulated rapidly to produce the desired final result instead of waiting for several manual iterations.

9. Conclusions

A personal computer can be an important office tool if connected into other office machines and properly integrated into **an office system**. It has a great deal of flexibility, and can often be tailored to suit the tastes, work habits and requirements of the user. Unlike dumb terminals, there is less tendency to saturate a central computer, since its free-standing capabilities are available after down-loading a selection of data. The PC also permits the sharing of many other facilities, like larger computing power, sophisticated graphics programs, laser printers and communications. It can provide rapid access to common data bases able to provide more up-to-date information than printed reports. Lastly, portable computers can access the same familiar office facilites from anywhere in the world where a telephone connection can be made.

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LANGLEY EXPERIENCE WITH ADABAS/NATURAL

Andrew Swanson, Coordinator
Chief, Business Data Systems Division (BDSD)
Langley Research Center

Langley has been using the ADABAS Data Base Management System, together with its companion software products NATURAL and COM-PLETE for a little over 4 years.

I will give a brief overview of those things that are operational using ADABAS and where we are in further application of DBMS technology. This will be followed by brief talks on some specific applications, including some users' views. As I am sure you know, the views of users and providers of ADP services are not always the same regarding how good (or poor) ADP support really is. But I think it will be apparent that we in ADP have provided our customers with some new and powerful capabilities that do assist them in getting their jobs done more effectively.

One of the tools we have provided is that of end-user computing. In addition to the broad variety of pre-formatted screens available for both update (data input) and reports (data query), many of our users write their own query programs using NATURAL. With this capability, our customers can often meet new requirements for data retrieval very rapidly without the need to involve ADP systems analysts and programmers.

The biggest problem that I believe we inflict on our customers is our failure to provide consistent, and consistently good, response time for on-line terminals. This is due, in part, to the success we have achieved. It was not long ago when I could easily keep track of the dozen or so terminals that accessed our system. About a year ago, the number of terminals had grown to about 100. It is now more than 200 with typically two or three dozen on-line at any given time and peaks in the range of 50 to 60.

Not all of these are end-user or ADP customer terminals. Use of interactive terminals by the ADP staff for ongoing maintenance of COBOL programs and the development of new applications using both COBOL and NATURAL also creates heavy workloads for the system.

We have upgraded our CPU from an IBM 4341 Model Group 11 with 4 megabytes of memory to a Model Group 12 with 12 megabytes, and we have a competitive procurement in process to obtain an even faster CPU in order to provide one key improvement element -- making more CPU cycles available per unit of time. We also have an ongoing effort to tune the system to improve response time. This includes specific efforts to ferret out and correct inefficient programs.

Figure 1 summarizes our principal uses of ADABAS in Administrative Support Systems, including both operational systems and those that are currently in development.

Figure 1. LANGLEY USES OF ADABAS/NATURAL

- STRIP AND LOAD
  - EXTRACT DATA FROM COBOL BATCH SYSTEM FILES AND LOAD IN ADABAS FORMAT ONTO DISK
- HYBRID MODE
  - ADD ADABAS FILES TO EXISTING COBOL SYSTEMS
    - AND/OR REPLACE NON-DBMS FILES WITH ADABAS FILES
- END-USER WRITTEN NATURAL PROGRAMS
  - GET NEW REPORTS NOW INSTEAD OF WAITING FOR THE ADP SHOP TO DO SOMETHING
- NEW OR REDESIGNED SYSTEMS (* = OPERATIONAL)
  - * BIDDERS (SOURCE) LIST
  - * PR/PO/CONTRACT TRACKING/INFO
  - CONTRACT CLOSEOUT - DUE 7/84
  - FINANCIAL MANAGEMENT (ACCOUNTING) - DUE FOR FY86
    - INVOICE/PAYMENT SUBSYSTEM - DUE 7/84
  - HUMAN RESOURCES INFORMATION SYSTEM - DUE FOR FY86
    - INTEGRATED PAYROLL/PERSONNEL SYSTEM
  - * TECHNICAL PAPER STATUS TRACKING
  - * BUDGET PLANNING/TRACKING
    - INCLUDES POP DEVELOPMENT SUPPORT
  - * SUPPORT CONTRACT STATUS/STAFFING INFORMATION
  - FABRICATION DIVISION (SHOPS) SUPPORT - DUE IN 85
    - TRACKS INHOUSE AND CONTRACT STATUS, HOURS, DOLLARS
  - * NEMS - AGENCY-WIDE SYSTEM
    - HEADQUARTERS-DEVELOPED USING LANGLEY COMPUTER
  - SUPPLY (INVENTORY) MANAGEMENT - DUE IN FY85
    - KEEP COBOL SYSTEM BUT USE ADABAS FILES

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STRIP AND LOAD DATA

by

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The Strip and Load process refers to a method of taking batch data files and loading these files into the ADABAS Data Base Management System (DBMS) for subsequent on-line query. ADABAS requires a sequential data set as input to the Loader Utility. For purposes of this document, we assume an IBM/MVS operating environment using COM-PLETE, ADABAS, and NATURAL. Other tele-processing monitors, such as CICS or TSO, are valid substitutes for COM-PLETE.

You just received your new ADABAS DBMS and the primary objective is to quickly become productive. The initial steps to becoming productive are to identify a prototype system and put it on-line. The prototype system should be small in scale but contain the complexity of larger scale systems. Once the prototype system has been successfully implemented, implement next the system with the most immediate benefit to the organization.

The process of defining the ADABAS data base is very simple. Most new ADABAS users simply define the new ADABAS file, field for field, to look like their old file. This procedure will work and is sometimes appropriate; however, with a little effort, you can avoid the potential pitfalls of poor disk utilization and poor performance. If a field is a derivative of other fields in the record, you may not want to store the field. Fields such as City and State may be replaced by Zip Code, Department Name may become a Table File, etc. ADABAS requires fields defined as numeric to contain valid numeric data. It is very important to look at the data values of each field you include in the data base. To assume fields have certain characteristics is not enough; you should run frequency distributions on each field.

One of the primary functions of a Data Base Management System is to provide access to the data. ADABAS provides access through fields defined as descriptors. Descriptors are like index catalogs in the library. Interview the proposed users of the system to determine how they will access the data.

The best descriptors are unique (e.g., Social Security Number) and the worst descriptors are non-unique (e.g., Sex Code 'M' or 'F'. The frequency distribution of the data values will tell you if the field is a good descriptor field or not so good. If a user accesses the data based on values from several fields, you can define a compound descriptor/"superdescriptor." If a part of a field is to be used in a search, for example, purchase order number positions 3 and 4 represent Directorate and Division, they can be made into a sub-descriptor. The phonetic descriptor can be used where the exact spelling of an alphabetic field is uncertain. In your evaluation of descriptors you should compute the on-line disk storage required and justify each descriptor. For Strip and Load Files, liberal use of descriptors is recommended. The only cost is on-line disk storage.

When you have defined the fields to be included in the data base and which fields will be descriptors, it should be documented and reviewed with the user for final concurrence and signoff. Many misunderstandings and erroneous assumptions have been corrected by doing a final documented review with the user prior to implementation.

Now, you are ready to define the data fields and files to the ADABAS DBMS. This is accomplished by using the on-line interactive data dictionary facility called "PREDICT." You must define each field and its attributes, whether it is a descriptor field, and what type of data compression. PREDICT will generate the loader definition statements required by the jobstream used to load a file to ADABAS.

The physical field sequence of the data file to be loaded to ADABAS must be in the same sequence as it was defined to ADABAS. Generally, this requires a COBOL program to reformat your non-DBMS file to conform to the ADABAS file definition. The ADABAS loader utility provides a user exit which gives control to the programer after the data is read and before the data is written and can be used to format data, thus saving one pass of the file.

Once the files are loaded, you can write NATURAL programs to query the data. NATURAL is an interactive development system designed for use with the ADABAS DBMS. If the user has not been trained in coding NATURAL, their basic requirement would be met with canned programs until such time as they are trained. Because these files are Strip and Load, no updating occurs.

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NATURAL GRAPHICS

by

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The computer graphics explosion has been fueled by the increased availability of graphics hardware and software offered at affordable prices. The Langley Research Center has been caught up in that explosion. During the past year Langley has increased graphics hardware and software, significantly improving the Center's graphics capabilities in both the scientific and the business environments. Two major graphics software packages, IBM's Graphical Data Display Manager (GDDM) and Precision Visual's DI-3000, have been acquired and placed in production here at the Center. This document deals only with the graphics produced by the Business Data Systems Division (BDSD) under the Management Operations Directorate.

A major component in any graphics system is the graphics hardware available to the user community. The GDDM software package requires an IBM or IBM-compatible computer capable of running the System/370 Instruction Set, 327X or 8100 Teleprocessing Control Unit, and 327X, 8775, 328X, 3800, or 4250 Terminal Output Devices. It is not sufficient to know what terminals and control units are supported by GDDM; you must also know what features and configuration supports are required. Generally speaking,you require programed symbols and the extended function feature.

The installation of graphics hardware at BDSD had its problems. Equipment ordered with program symbol support arrived without program symbol support, causing some confusion and a lengthy reorder process.

Our current graphics configuration consists of the IBM 3279 Color Display Station which is a tabletop high-resolution Color Cathode Ray Tube Display. The 3279 is classified as a raster terminal with each character containing a 9x12 point dot matrix. For passive hard copy output we use the 3287 and 3268 Printers with multi-color ribbon cartridges with colors red, blue, green, and black. The 3287 and 3268 are dot matrix Printers.

BDSD looked at several graphics software packages and selected a combination of GDDM and NATURAL graphics. During the evaluation and selection period, it was clear that all of the graphics software packages required GDDM to drive the 3279 terminals. Therefore, GDDM was an obvious choice without preempting any of the other graphics software packages should it be determined that they are required or desirable. The possibility exists in the future that we might acquire Precision Visual's DI-3000 to give us compatibility with the scientific computers in the Analysis and Computation Division (ACD). A primary reason for attaining this compatibility is the mass storage system which BDSD could use for storing charts and later outputting them to passive hard copy devices, or interacting with graphics hardware under the control of the Control Data Corporation Network Operating System (NOS) computers.

The software configuration required to run GDDM graphics consists of IBM's Advanced Communications Function-Virtual Telecommunications Access Method (ACF-VTAM) and IBM's Time Sharing Option (TSO), or Virtual Machine/Conversational Monitor System (VM/CMS), or Customer Information Control System (CICS). GDDM currently does not function under our teleprocessing system COM-PLETE. However, the next release of COM-PLETE does support GDDM and the extended functions of the 3279 terminal. Testing will be conducted to see if graphics users and general query users can mutually co-exist in COM-PLETE before discontinuing TSO.

GDDM is a base graphics product and, as such, has many adjuncts. For the business graphics, we selected the Interactive Chart Utility (ICU) and the Presentation Graphics Feature (PGF). A significant problem in business graphics is the ability to present the data to the graphics software in such a format as to obtain the desired output graphics with little technical knowledge or effort. To meet this requirement, BDSD selected the NATURAL graphics software package marketed by Software AG of North America.

NATURAL graphics interfaces with ADABAS, our Data Base Management System, at a very high level and, because we have trained over 100 employees in NATURAL programing, it seemed natural to acquire NATURAL for our graphics. NATURAL graphics has two verbs which allow graphics. They are 'PLOT' and 'DRAW'. PLOT is used to identify and accumulate the data points, and DRAW is used to tell the type of chart to draw and when to draw the chart. All of the capabilities of NATURAL are inherent in NATURAL graphics.

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ASYNCHRONOUS FILE TRANSFER TO IBM PC's

by

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The Asynchronous File Transfer System is used for interactively selecting and transmitting text files from the BDSD host processor to an IBM Personal Computer. The IBM asynchronous communications support package is used for handling the communications on the Personal Computer. An application program (NATURAL, COBOL, etc.) is used for selecting and formatting the records to be transmitted, and three subroutine modules residing on the BDSD host processor are used for interfacing the application program and the communications software.

Each record transmitted to the Personal Computer must be in the standard ASCII format as illustrated below. This record format is directly accessible by BASIC and many of the Personal Computer software packages provide utility programs for converting them to the format required for the particular package in question.

Standard ASCII Format

data,data,"data, data",dataCRLF

In this format each data value is separated by a comma. A data value that has a comma embedded within it must be enclosed within quotation marks. The record is terminated with a carriage return (CR) and line feed (LF) character sequence.

Hardware and Software Requirements

The following hardware and software is needed to access the BDSD host processor:

IBM Personal Computer

- 64K bytes memory
- Asynchronous Communications Adapter
- IBM Disk Operating System (DOS) and Disk BASIC
- IBM Asynchronous Communications Support Version 2.0 (modified by BDSD)

How To Use the Asynchronous File Transfer Facility

Prior to using the Asynchronous File Transfer Facility, a terminal specification for accessing the BDSD host processor must be defined. The terminal definition parameters must be set as follows:

1 - Line Bit Rate (300 or 1200)
2 - Type of Parity Checking (Even)
3 - Number of Stop Bits (1 Bit)
4 - XON/XOFF Support (Absent)
5 - Line Turnaround Char Sent to Host (XOFF)
6 - Local or Host Character Echoing (Local)
7 - First Character To Be Deleted (All)
8 - Second Character To Be Deleted (LF)
9 - Third Character To Be Deleted (XON)
10 - Fourth Character To Be Deleted (None)
11 - Line End Character Send by Host (CR)

The application program is responsible for selecting and formatting the records making up the file to be transmitted. Each record must be terminated with a carriage return character (ASCII Code - OD). Consult the Personal Computer documentation for restrictions on the ASCII file format. The application program can be written in any language supported by COM-PLETE (BDSD's teleprocessing monitor).

The subroutine modules must be called by the application program to facilitate the file transfer. These modules are described below.

FILEOP - The FILEOP module should be called prior to entering file capture mode on the Personal Computer. It sends the message READY DISK FOR FILE TRANSFER to the Personal Computer and waits for the operator to ready the disk and reenter terminal mode. After terminal mode has been entered, the operator must depress the return key to inform the host processor the file transfer is ready to be started.

Format - CALL 'FILEOP'. (COBOL)
CALL 'FILEOP' #DUMMY (NATURAL)

Arguments - #DUMMY - Identifies a dummy argument required for the NATURAL CALL statement.

FILEWT - The FILEWT module must be called for each record to be transmitted. This module converts the record passed by the application program into a format suitable for transmission. A line feed (LF) character is appended to the end of the record prior to transmission.

Format - CALL 'FILEWT' USING #RECORD. (COBOL)
CALL 'FILEWT' #RECORD (NATURAL)

Arguments - #RECORD - Identifies the record to be transmitted. The maximum length is 250 characters.

FILECL - The FILECL module must be called after all records have been transmitted. This module sends an end-of-file character (hexadecimal 1A) and the message FILE TRANSMISSION COMPLETE to the Personal Computer. This message will be

recorded on the Personal Computer's disk but will not be included as part of the file due to the end-of-file indicator preceding it. When the terminal operator receives this message, the file capture mode on the Personal Computer should be ended. The operator then returns to terminal mode.

Format - CALL 'FILECL'. (COBOL)
CALL 'FILECL' #DUMMY (NATURAL)

Arguments - #DUMMY - Identifies a dummy argument required for the NATURAL CALL statement.

Sample Program -

```
RESET  #Q  (A1) #C (A1) #CR (A1)  #DUMMY  (A1)
       #RECORD (A250)
MOVE H'0D' TO #CR
MOVE ',' TO #C
MOVE H'7F' TO #Q
CALL 'FILEOP' #DUMMY
READ TERM-CONF WITH DECAL
COMPRESS #Q MAKE #Q #C DECAL #C #Q CONTACT #Q #C PHONE
         #C #Q ACCESS #Q #CR INTO #RECORD LEAVING
         NO SPACE
CALL 'FILEWT' #RECORD
LOOP
CALL 'FILECL' #DUMMY
END
```

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STATUS TRACKING SYSTEM FOR REPORTS

Jeanne P. Huffman
Langley Research Center

The program DGR03 "Status of Langley Formal Reports" was developed to aid the Research Information and Application Division (RIAD) in tracking the progress of NASA formal reports through the review cycle.

This review cycle (Figure 1) was established by Langley Management in NACA days as a control for Langley's final product: its research reports. The cycle is divided into 5 main stages with substages in each. In the 1960's, 180 days were arbitrarily set as the optimum time for completion of the cycle. More recently (in the 1980's), management decided that the cycle could be completed in 165 days.

Accordingly, the 165 days were allotted to the 5 stages as shown on the slide, beginning when the Division sets up a technical editorial committee and ending when Publications Branch mails the printed report.

Mailing of the report is considered the "target date." Before the days were allotted to various organizations, reports could lie around for months, then typing and printing would have to take up the slack to meet the target date. Until the BDSD program was established, the Research Information and Applications Division was responsible for keeping records and calculating for every report in the system the target date, the number of days and the calendar dates for each stage, the number of reports published in a calendar year, and the total number of printed pages. In addition, these numbers for all the reports were averaged by hand to give average days for each stage every month. At the end of the year, averages were calculated for each stage based on the total number of reports published. With the program DGR03, clerical personnel from various branches in RIAD input all the data using NATURAL language and on-site terminals (MEMOREX 1377). Printouts are requested remotely and are delivered by the messenger service. The usual procedure is to update each stage and request printouts weekly.

The figures shown are representative of the computer printouts [raise printouts] but have been modified for the sake of brevity and legibility. Only one line from each of the six sections is shown. Figure 2 shows the papers in Editorial Review, which means they are in the technical review stage in the originating division. The Technical Editorial Committee meets and makes recommendations to the author. The author then revises the paper for concurrence of line management and the TEC chairperson. All this is supposed to occur within 49 days. Then the paper is due in the Technical Editing Branch. The target date shown on the right is 165 days from the date it "left division." The information shown at the top appears on all the printout pages but has been omitted from the slides.

Figure 3, "Papers in Technical Editing" is concerned mainly with the date the report is received in Technical Editing (TEB) and the date the author is called for the interview with the editor. The time allotted between these two dates is 29 days. The report is again charged to the author until the discussion with the editor is completed and final figures are prepared. When the editor has the rough draft marked and the final figures ready, the report goes to Technical Documentation for final typing (Figure 4). Again the days from "Typing received" until the report is "mailed to author" are the days that are counted; 23 was the number allotted here.

PRECEDING PAGE BLANK NOT FILMED

After the report is typed and the author performs the final review, the next stage is "Finals in Technical Editing." (Figure 5). Here the report is proofread for typos, then the author's corrections are incorporated and the report goes back to typing for final corrections. The days (7) are counted from "author copy received" to "shipped to Printing Control (PC)." The sample on the slide is not going to make the target date.

Printing Control (Figure 6) represents the printing and mailing (distribution) by the Publications Branch. The time allotted for this step is 20 days. The report shown here was mailed about 6 weks before its target date.

Program DGR03 next gives processing days for all reports with the number of actual days in each of the steps you have just seen. (Figure 7). The report is separated by research organization (division) and those days that exceed the allotted times are flagged.

After the days for each report in each division are shown, the averages are displayed (Figure 8). The averages are for all the reports in the period to date, which is the same as the year to date, and are computed when the reports are mailed ("mail-out date"). This report can be very unnerving. Many of the reports that were processed last year (a bad year) were mailed in 1984, and there have not been enough reports with "good" figures mailed to bring the averages down yet.

Figure 9 gives totals, which are actual numbers of reports processed, edited, typed, and mailed for the year to date.

The report summary (Figure 10) was established for the research organizations to enable them to see actual dates. This summary report also is divided by research division and distributed to the divisions monthly. RIAD highlights those reports that are delinquent, and the research divisions find the causes for the delays.

This program has been an aid to RIAD in

- eliminating manual calculation
- providing visible data for everyone concerned with report processing
- eliminating the need to telephone divisions when reports are delinquent

The program can also provide information on the number of reports in any stage of the system at any period. This can be advantageous to compare, for example, the number of reports in Technical Editing for the first quarter of 1983 with the number for the first quarter of 1984.

A future refinement would be the capability to give an average of the total processing days at any stage during processing in addition to the average based on the reports mailed. For example, it would be desirable to know the average days in Technical Documentation for those reports typed in CY 84.

RIAD's use of the program would also be enhanced by having personnel with programming experience. Possibly, some of the clericals who input now could attend classes in programming in NATURAL.

REPORT REVIEW CYCLE

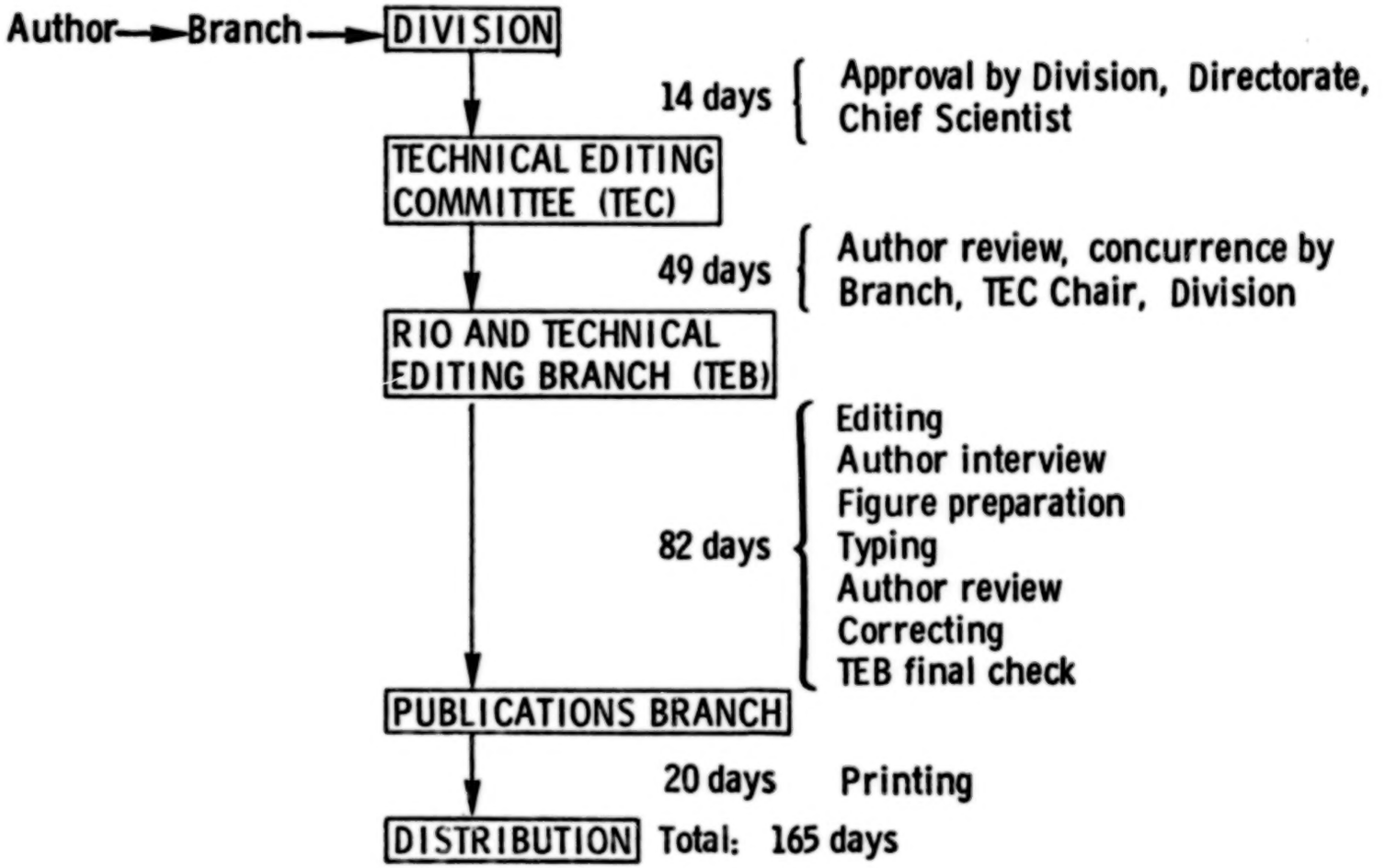

Figure 1

NASA-LRC-BDSD Report DGR03-01
Data as of 01/01/84 to 04/27/84

Status of Langley Formal Reports
Papers in Editorial Review

Process Date 04/30/84

Flight Dynamics & Control Div					
author's name	L number classif	left division	meet date	due in TEB	target date
Grantham W D (TP)	15805 Unclas	04/23/84	05/16/84	06/25/84	10/05/84

Figure 2

Papers in Technical Editing

Transonic Aerodynamics Div							
author's name	L number classif	in TEB	assigned	days unassigned	editor	author called	target date
Chu J (TM)	15709 confid	04/12/84	04/18/84 042684 disc	006	WSM	04/24/84	04/29/84

Figure 3

Papers in Technical Documentation

Low-Speed Aerodynamics Div							
author's name	L number classif	typing rec'd	typing assigned	days unassigned	typist	mailed to author	target date
Grafton S B (TM)	15762 Unclas	04/20/84	04/20/84 37 pages	000	DLG	04/26/84	07/23/84

Figure 4

Finals in Technical Editing

Flight Dynamics & Control Div								
author's name	L number classif	report no	mailed to author	rec'd from author	typing assigned	rec'd from typing	shipped to PC	target date
Young J W (1P)	15696 Unclas	TP2293		04/20/84	04/20/84	04/26/84	04/30/84	04/20/84

Figure 5

Papers in Printing Control

Structures & Dynamics Div						
author's name	L number classif	report no	in prt control	mail out date	pages	target date
Thomson R G (TP)	15757 Unclas	TP2298	04/11/84	04/24/84	44	06/05/84

Figure 6

Processing Days

Loads & Aeroelast Div												
author's name	L number	TEC (014)	div (049)	TEB (029)	author (013)	typing (023)	author (010)	finals (007)	printing (020)	total RIAD (079)	total auth/div (086)	total (165)
Cunningham H J	15708 (TP)	16 *	91 *	12	32 *	13	6	6	16	47	145 *	192 *

Subsonic Kernel Function . . .

* Exceeds maximum number of days

Figure 7

Processing Days

formal reports (does not include CPS)	TEC (014)	div (049)	TEB (029)	author (013)	typing (023)	author (010)	finals (007)	printing (020)	total RIAD (079)	total auth/div (086)	total (165)
mailed total PTD 47	838	4064	1923	1414	1179	555	290	815	4207	6871	11078
average days	18*	86*	41*	30*	25*	12*	6	17	90*	146*	236*

*Exceeds maximum number of days

Figure 8

Pericd-to-Date/Year-to-Date Totals

processed		edited		typed		mailed	
PTD	YTD	PTD	YTD	PTD	YTD	PTD	YTD
70	70	68	68	61	61	53	53

Figure 9

Formal Report Summary

Acoustics & Noise Reduction Div										
author's name	L number	left division	ed meet date	in TEB	author called	typing rec'd	mailed to author	rec'd from author	shipped to PC	mail out date
Leatherwood J D	15745 (TP)	01/05/84	01/23/84 *	02/15/84	02/28/84	03/12/84	03/22/84	04/02/84 *	04/04/84	04/16/84

A Computer Program for Vehicle Ride Quality

* Exceeds maximum number of days

Figure 10

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THE NBS DATA MANAGEMENT TECHNOLOGY PROGRAM

by

Helen M. Wood
Institute for Computer Sciences and Technology
National Bureau of Standards

INTRODUCTION

Computers, peripheral equipment and software comprise over $80 billion in annual U.S. industry revenues. With computer technology proving to be a major key to increased productivity in all sectors of the economy, it is essential that organizations use the technology effectively. Rapid changes in technology provide additional challenge to this task.

The Institute for Computer Sciences and Technology (ICST) at the National Bureau of Standards (NBS) manages a Government-wide program to help organizations exploit computer technology. ICST activities include the development of standards and guidelines, the provision of technical assistance to agencies, and the conduct of applied research. Major problem areas addressed include:

- computer security
- software engineering
- programming languages
- data management
- computer graphics
- micro-based systems
- computer networking
- computer storage media.

While these topics are not mutually exclusive, they provide focus and orientation for projects aimed at improving the management and use of computer technology. This paper describe activities in the NBS Data Management Technology Program.

DATA MANAGEMENT TECHNOLOGY

Rapid increases in the costs associated with software development and maintenance have caused organizations to turn to other methods of application development, including packaged software, report generators and data base management systems (DBMSs). These alternatives, however, have not always yielded expected cost savings due to such factors as:

- lack of understanding of application requirements
- ignorance of software limitations, or
- inadequate utilization of software capabilities.

The NBS Data Management Technology Program is concerned with helping agencies improve their management of data resources by promoting the educated use of data management tools and techniques. Emphasis is placed on identifying the organization's data requirements and economically capturing, maintaining and accessing those data in a machine-processible form. Program activities, products and plans will be described for the following areas:

- Data administration
- Data management software
- Database architecture
- Data transfer and conversion.

Data Administration

Data administration covers a broad span of activities which range from identifying mission critical data to assessing the adequacy of controls on highly sophisticated database technology.

Until recently, NBS activities in this area have concentrated on the development and maintenance of standard data elements and representations for common Federal applications, with particular emphasis on geographic data codes. FIPS PUB 55, for example, contains over 155,000 entries providing unique codes for populated places, primary county divisions, and other locational entities. Another product in this area, FIPS PUB 95, provides standard codes for the identification of Federal and Federally-assisted organizations.

While continuing to maintain existing standards, NBS focus in this area has shifted to providing more generic assistance to agencies in the (1) definition of their data requirements; (2) selection and use of appropriate tools, such as data dictionary software, for the control of data; and (3) identification of additional, critical requirements such as data security and integrity.

Data Management Software

The objective of activities in this area is to improve the management of valuable information resources through the development of (1) standard specifications for critical software systems, including DBMSs and Data Dictionary Systems (DDSs); and (2) guidance on choosing from among alternatives such as network or relational DBMSs, file management-type systems, and more traditional (e.g., COBOL-based) approaches. Opportunities and risks inherent in the use of micro-based DBMSs are also considered.

At present, there are no existing international, national, or Federal database standards. However, proposals are currently

under critical review within the American National Standards Institute Committee X3H2. These proposals specify structures and operations for the network and relational data models, called the Network Data Language (NDL) and Relational Data Language (RDL). The structures and operations specified are typical of existing capabilities in a wide variety of DBMS products. Thus, the proposed languages can be used for comparison purposes in DBMS selections, even before the existence of conforming products. A recent NBS report describes these data models and discusses how they might be used in the selection of DBMSs.

NBS has developed draft technical specifications for data dictionary systems. These specifications have been reviewed by a wide range of Federal agency representatives, private industry users, and software suppliers and, in addition, have been adopted by ANSI Technical Committee X3H4 as a base document for the planned standard information resource dictionary system. Preliminary cost-benefit studies estimate that the Government could realize over $120 million in benefits by the early 1990's from the use of a standard DDS.

Database Architecture

Activities in this area are aimed at (1) the selection and use of data design methods and tools, and (2) guidance for managing the performance of data management systems.

A guide to good practice in logical database design is under development. This report describes a recommended methodology for identifying and capturing critical data and relationships among those data, independent of the software and hardware environment. Emphasis is on support by a data dictionary system, graphic presentation for ease of understanding and validation, and the use of normalization for quality control.

The second project is concerned with helping users select from among such alternatives as database machines, minicomputer, and microcomputer-based DBMSs. Emphasis is on hardware, not software, with the objective being to provide guidance on making a good first-cut at hardware selection for a DBMS application. A benchmark-based approach has been used, involving records extracted from the central civilian personnel database maintained by the Office of Personnel Management. Two reports are planned: one describing a comprehensive benchmark methodology for use on database systems, and the other summarizing the methodology and presenting the results of the benchmark experiments conducted.

Data Transfer and Conversion

Transporting a database between systems is typically costly and time-consuming. Standard data models (e.g., the NDL and RDL activities described above), along with standard formats for

data interchange, can significantly reduce the expenses associated with both data transfer and conversion. Furthermore, such standards can smooth the way to truly distributed database environments.

A recent NBS report describes approaches to database translation, discusses candidate interchange forms, and recommends a method for representing the data structures of the proposed NDL and RDL specifications in a form suitable for database interchange.

CONCLUDING REMARKS

The NBS Data Management Technology Program addresses major problems encountered during the following stages of an application's lifetime: requirements analysis and database design, system selection and implementation, operations management and conversion. Products developed include standard software specifications, guides to "best practice," standard data elements and representations, and reports documenting the experiences of other organizations as they attempt to improve the management of their computing resources.

Database Laboratory facilities are maintained for the investigation and analysis of state-of-the-art database technology. These facilities support collaborative testing with researchers, vendors, users, and standards developers.

A Federal Data Management Users Group has been established by NBS to foster technical information exchange and to aid NBS in the identification of Federal needs. This users group meets quarterly at NBS.

Additional information and a list of reports, standards, and guidelines published by this program can be obtained by contacting:

NBS Data Management Technology Program
National Bureau of Standards
A255 Technology Building
Washington, D.C. 20234
(301) 921-3553

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DATA COMMUNICATION

BETWEEN DATA TERMINAL EQUIPMENT AND THE JPL ADMINISTRATIVE

DATA BASE MANAGEMENT SYSTEM

BY

ROBERT W. IVERSON

INTRODUCTION

Scope

This paper discusses approaches to enabling an installed base of mixed data terminal equipment to access a data base management system designed to work with a specific terminal. The approach taken by the Jet Propulsion Laboratory and our experiences to date are described.

Background information on the Jet Propulsion Laboratory (JPL), its organization and a description of our Administrative Data Base Management System is included.

Background

The data base management system need of JPL is unique amoung the NASA Centers. JPL is an operating division of the California Institute of Technology (Caltech). Caltech/JPL performs research, development and other related activies under contract with NASA using facilities provided by the government. The Caltech/JPL contract requires NASA standard administrative and financial reporting. However, the design and operation of the internal JPL management and administrative support systems are the responsibility of Caltech.

JPL is organized as a matrix, Projects and tasks are formed and funded within the Program offices as required and approved by NASA. The work is performed by the Technical Divisions in accordance with the requirements and guidelines established by the Program and Project offices. Financial, Procurement, Personnel and other administrative support is provided by the the Administrative Divisions.

Some large Planetary research and development projects currently being managed by JPL include the VOYAGER, GALILEO and IRAS Projects.

COMPUTING AND INFORMATION SERVICES

THE CISSP

In 1983, the Computing and Information Services System Project (CISSP) was formed with the primary objective of developing and adopting up-to-date computing ,networking, and information services technology to meet the future data processing and data management requirements of JPL. The CISSP is comprised of two parts:

> Development of a computer-communications network called the Technical and Administrative Computer Communications Network (TACCN).
>
> The upgrade of JPL's Management and Administrative Support Systems, (MASS) the systems and data which support the management and administration of the laboratory.

The use of the TACCN to provide user access to the MASS is the subject of this paper.

THE MASS

The previous administrative support systems at JPL have been developed ad-hoc and uncoupled. Our Resource management, Procurement, Inventory, Cost accounting, Payroll and similar systems have operated in a stand-alone, batch, labor intensive environement.

In 1982, plans for an integrated, interactive Management and Administrative Support System (MASS) were developed and implementation of this system was started in 1983 with the establishment of the CISS Project and the procurement of a generalized data base management system. A IBM 3083 Computer was procured early in 1984 to host this system.

The overall implementation precept for the MASS is to procure commercially available applications software wherever possable. One of the foundations of this precept is the use of a commercial generalized data base management system. The Integrated Database Management System (IDMS) by the Cullinet Corporation was selected as this foundation. The selection of IDMS dictates a set of applications which can be purchsed to perform MASS functions. The commercial availability of applications compatable with the Cullinet IDMS determines the order in which the JPL systems will be implemented. A characterization of the target applications of MASS when all elements have been completed is shown in figure 1.

FIGURE 1

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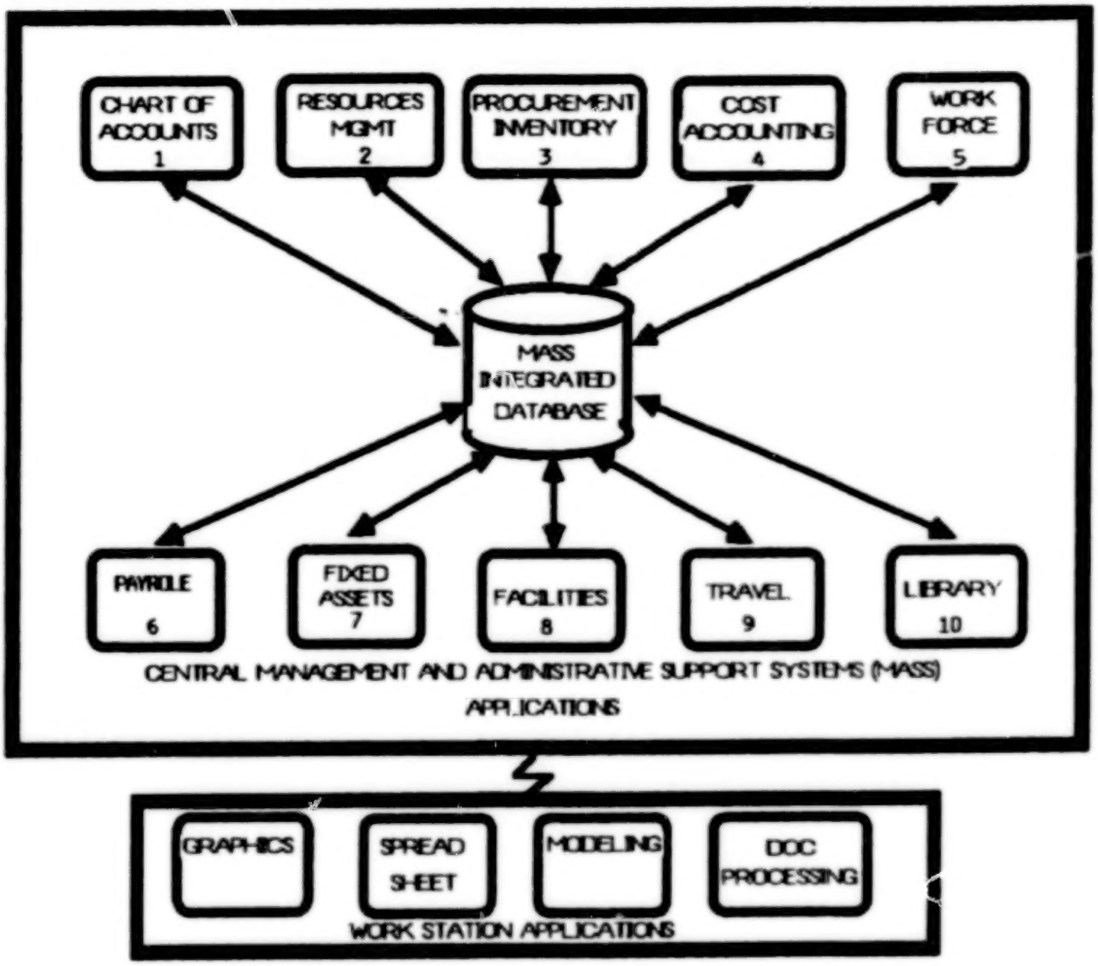

TACCN

The TACCN is being developed concurently in support of the MASS. The major elements of the TACCN are shown in figure 2. These include:

* The IBM 3083 Computing System which hosts the MASS software.
* The Institutional Local Area Network (ILAN) which provides reliable high speed data communications between terminals, from terminal to computer and computer to computer.
* File and print servers on the network.
* Electronic message store and forward services.
* Office Automation services
* Science and Engineering computing services.
* Flight Project Support Services

THE DATA COMMUNICATION ENVIRONMENT

THE ILAN

The ILAN will provide the primary data communications functions for the laboratory. The ILAN uses Broadband technology and is based on hardware and software purchased from the Ungerman-Bass Company. It will provide on line data communications for over 1000 users. Additionally, dial communications facilities will be provided via a Northern Telecomm Digital Telephone central office provided by Pacific Telephone Co.

There are currently over 1500 Data Terminal Equipment (DTE) units at JPL. There are over 100 separate models or types of DTE which must be served by the ILAN and the MASS. The major users of the MASS (The Program and Project Office, The Administrative Divisions and the Technical Division Management) use Micro computer workstations (IBM PC/XT), Word Processors (WANG), Executive desk sets (Northern Telecomm Display Phone), and Portable hardcopy terminals such as the TI Silent 700's.

FIGURE 2

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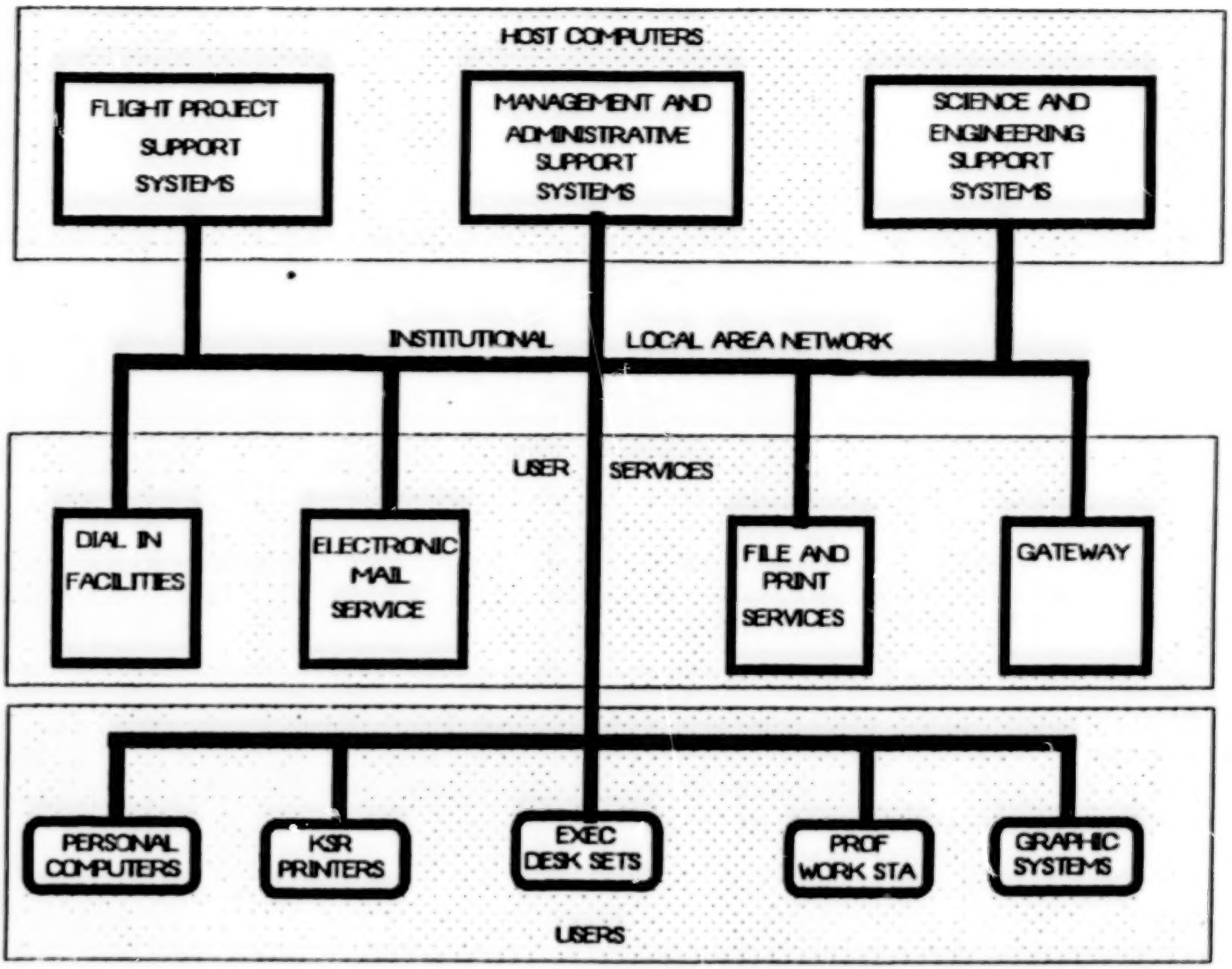

FIGURE 2- ELEMENTS OF THE TECHNICAL AND ADMINISTRATIVE COMPUTING AND COMMUNICATIONS NETWORK (TACCN)

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THE MASS/TERMINAL INTERFACE

Ideally, all terminals connected to the MASS/IDMS/IBM 3083 would be IBM 3278 terminals (or their equivalent), each operating at 9600 bps allowing the transmittal and receipt of a complete CRT screen in one second. However, because JPL's inventory of terminals includes only about 30 IBM 3278 terminals it is nessesary to find ways to either adapt the non-compatable terminals to the MASS communication environment or to adapt the MASS environment to over 100 different types of terminals. The later option would violate the fundimental precept of a commercial generalized database management system and applications.

Effective use of the large inventory of DTE will require one or more of the following work-arounds:

* Install IBM 3278 emulator hardware or software in the Micro-computer based terminals and connect them to a IBM 327x controller via coax cables.

* Install IBM 327X controller emulation in the Micro-computer terminals to allow direct host connection via the ILAN.

* Replace 327X controlers with protocol converters to allow asynchronous devices to operate in the MASS/IBM 327X/SDLC environment.

Possible configurations of these options are shown in figure 3. The first two options are attractive for IBM PC's or their clones. We plan to use emulators where possible. The availability of commercial emulation packages for other micro-computers is uncertain at this time.

FIGURE 3

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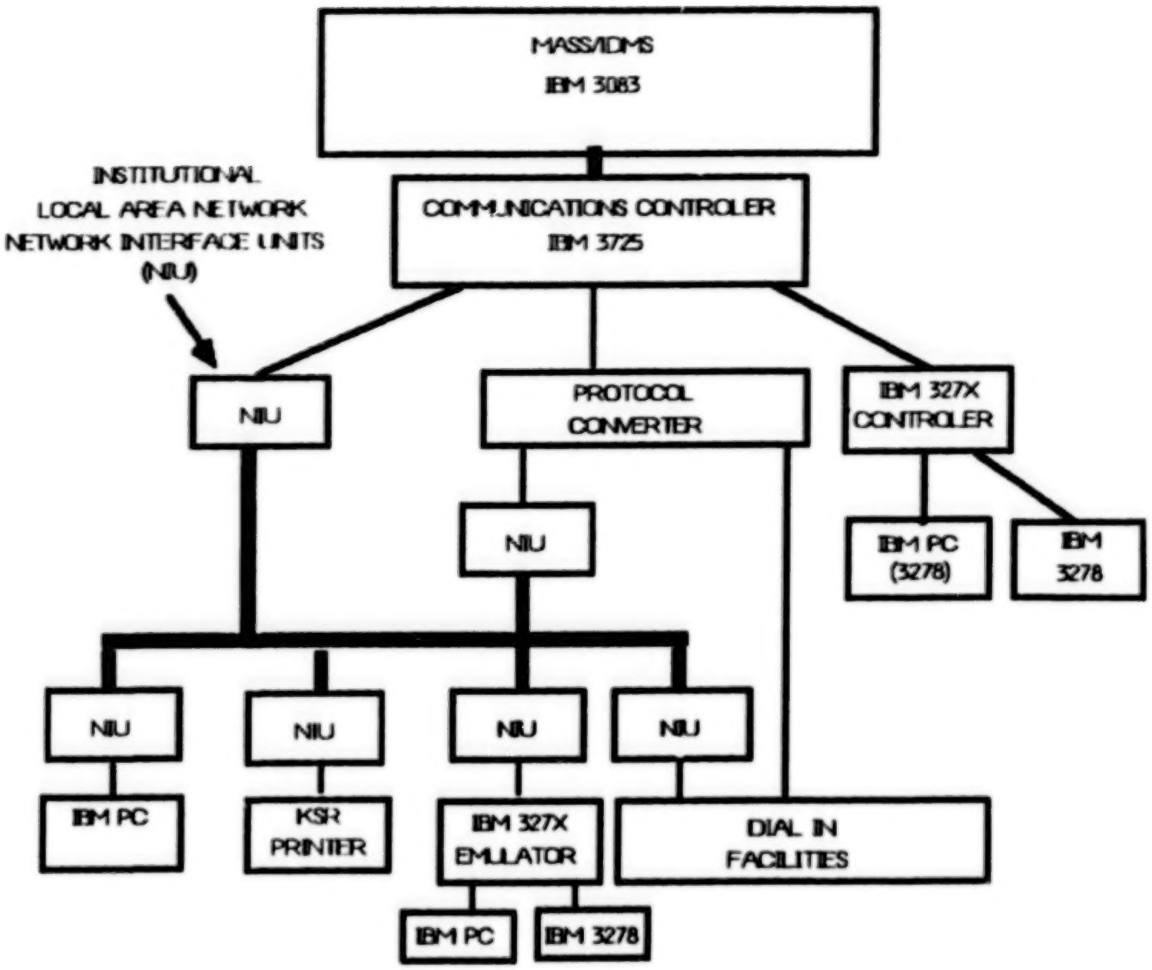

FIGURE 3- ALTERNATIVE METHODS OF PROVIDING A IBM 327X/SNA ENVIRONMENT

Two protocol translators purchased from the Renex Corporation have been installed at JPL for evaluation. The Renex Translator display system interfaces with the IBM communications processor in exactly the same manner as an IBM 327X control unit. The host thinks that the Translator is a 327X and communicates with it in the same manner. Asynchronous terminals connect to the Translator which has control over the data and cursor positioning at the terminal.

According to the Renex Corporation, almost any asynchronous ASCII terminal which can operate in the full duplex, character mode and which has an addressable cursor can be supported by the translator. It optionaly supports Keyboard Send/Receive (KSR) printers such as the TI silent 700's for both line by line and full screen applications. However, invoking some 3278 functions such as screen refresh on a KSR will cause all 24 lines to be printed (at 300 baud this may take a while). There is a set of PROM's which are available for installation in the translator which supports most commonly used terminals.

The JPL experience to date with the protocol translator approach has been mixed. The protocol translation function appears to work as advertised except for some KSR terminals. The desired MASS environment should allow for data file upload and download and this capability is not available for many terminal types.

CONCLUSION

The objective of the Computing and Information Services System Project is to provide up-to-date computing, networking and Information services technology at JPL. This includes an integrated, interactive Management and Administrative Support System utilizing commercially available data base management and applications software compatable with the IBM System Network Architecture (SNA). Our capital investment in a large inventory of non-SNA terminals requires some temporary work-arounds which include use of protocol translators. The use of a error free data communications system (the ILAN) and 327X emulators in or near the micro-computer based equipment will provide a longer term solutions while allowing flexibility in the replacement of the older equipment as it becomes obsolete.

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NASA METROLOGY INFORMATION SYSTEM - A NEMS SUBSYSTEM

Earl S. German, Jr., and Frederick A. Kern
Langley Research Center

and

Rick Yow and Ellen Peterson
Planning Research Corporation

ABSTRACT

The NASA Metrology Information Systems (NMIS) is being developed as a standardized tool in managing the NASA field Centers' instrument calibration programs. This system, as defined by the NASA Metrology and Calibration Workshop, will function as a subsystem of the newly developed NASA Equipment Management System (NEMS). The Metrology Information System is designed to utilize and update applicable NEMS data fields for controlled property and to function as a stand alone system for noncontrolled property. The NMIS provides automatic instrument calibration recall control, instrument historical performance data storage and analysis, calibration and repair labor and parts cost data, and instrument user and location data. Nineteen standardized reports have been developed to analyze calibration system operations.

INTRODUCTION

The National Aeronautics and Space Administration has conducted an annual workshop on metrology and calibration since 1977. The objectives of these workshops were to ensure effective support for NASA's technical programs, to identify areas where greater efficiency and economy could be achieved, and to provide a unification of field Center objectives and responsibilities. The workshops, under the sponsorship of NASA Headquarters' Office of Chief Engineer, included representatives from Headquarters, each field Center, support service contractors, and invited guests from other agencies such as the National Bureau of Standards and the Department of Defense. For the past 2 years the workshop has been held in conjunction with the Department of Energy's Standards Laboratories Manager's Conference.

The activities of these workshops have resulted in: (1) A unification of responsibilities and objectives through the development of an agency-wide management instruction, NMI 5330.9; (2) the development of a document describing the calibration capabilities of each Center; (3) an increase in the level of communications between Center metrologists concerning management techniques, calibration techniques, hardware, automatic calibration systems, software, and procedures; (4) NASA-wide labels for calibration, limited calibration and standards identification; and (5) the utilization and sharing of calibration resources between government agencies. However, the individual Center's

metrology programs still had significant differences--particularly in the procedures used to track instrument calibration histories, manpower usage, and calibration laboratory performance. For example, Center metrology programs ranged from the simple instrument calibration with minimal documentation and no instrument recall program to a system containing several thousand instruments in recall and a sophisticated instrument and calibration laboratory performance documentation system.

Since 1979, the Supply and Equipment Management Branch of NASA Headquarters has briefed each workshop on the NASA Equipment Management System (NEMS) being developed for agency-wide use. During the development, several standard data elements, which are output products of the calibration laboratory, were defined and installed in NEMS. However, these elements did not provide the Center metrologist with all the data required to evaluate calibration laboratory performance, metrology system efficiency, and instrument performance. During the sixth workshop held at the Johnson Space Center in October 1982, the group made the decision to develop a NASA-wide computerized management and information system designed specifically to support the field Centers' calibration programs. Since the NEMS contained a number of data elements required by the Center metrologists, this agency-wide system would be developed as a subsystem of NEMS. The first planning and development meeting was held at the Kennedy Space Center in February 1983, with the objective to define the core data elements required for the subsystem. From a review of the NEMS data elements, 25 elements were identified as required (fig. 1). Twelve additional data elements (fig. 2) unique to the subsystem were developed. A second meeting was held at the Jet Propulsion Laboratory in April 1983, to finalize core data elements, data element definitions, input document elements, and to begin to define output reports required. The Langley Research Center was selected as the lead Center to develop this subsystem with funding provided in July 1983, and program analyst and programer contracted for in October 1983.

DESCRIPTION OF SYSTEM

The NASA Metrology Information System (NMIS) is an agency-wide automated data processing system designed to improve the field Centers' instrument service programs, provide for automatic calibration recall of all or selected instruments, and to standardize the data base necessary to support and evaluate the effectiveness of these programs. Although the NMIS is designed to function as a subsystem of the NEMS, it can function as a stand alone system if necessary. The data base necessary to track, report, and summarize both instrument historical and metrology system performance is maintained under the ADABAS Data Base Management System (DBMS). The software is written in NATURAL, the ADABAS on-line interactive processing language, and COM-PLETE, a teleprocessing monitor, which allows the user additional flexibility for ad hoc data query capability. The NMIS has been designed to operate on the IBM 4341 OS/MVS compatible computer. The system uses either the IBM 3270 protocol terminal or an IBM personal computer for performing on-line transactions, conducting ad hoc inquiries, and other system operations. These

terminals will reside in the field Centers' Metrology Control Center which will be responsible for general data entry, report generation, software control, backup and error recovery, and metrology system data flow. The NMIS transaction processing is designed to pre-edit the input data entered through formatted screen displays and then use this data to update the data base. There are 26 transactions developed to add records, modify, or delete records in the data base. Each transaction has data elements and/or table entries which are either mandatory, optional, or not applicable, while other data elements are automatically generated.

The NMIS provides users with statistical summary performance reports, status reports of metrology related NASA controlled and noncontrolled instruments, and reports for monitoring the metrology system activities. These 28 reports are either generated automatically on a scheduled basis ranging from daily to annually or on-request only.

The majority of instruments that will normally be contained in the NMIS will be identified using the NEMS Equipment Control Number (ECN). However, many noncontrolled instruments must also be controlled by the NMIS. Identification of these instruments will be accomplished using a vinyl Metrology Control tag, similar to the NASA ECN, which is 1.35 x 0.6 inches in size. The tag (fig. 3) displays both the easily readable six character number, C00138 for example, and its equivalent bar code in a three of nine format.

METROLOGY CONTROL DOCUMENT

Since the field Centers' metrology programs have developed independently according to the specific missions, operational procedures and supporting documentation such as instrument work orders and on-site shipping forms are necessarily different. In order for the NMIS to function on an agency-wide level, certain segments of the Centers' procedures and documentation must be standardized. During two meetings held at the Kennedy Space Center and the Jet Propulsion Laboratory in 1983, a single form was conceptually developed and agreed upon by the participants. During the development of the NMIS Design Document, this Metrology Control Document (figs. 4, 5, and 6) was further developed to satisfy specific data element requirements for the instrument history and performance analysis reports.

This form consists of five sections. The user information section and the background information section are computer preprinted from data in the NMIS data base. The background information section contains labor, parts, and outside service cost data. Most important, however, is the "condition received" and "action taken" blocks which list the codes for the last "X" times serviced up to a maximum of eight times. This will allow the Metrologist to easily identify an instrument which is either unstable, misapplied, or used in an environment which could be degrading the performance. The user-technical monitor area section provides instructions and technical approval for the required work. The calibration-repair information section contains data blocks which are completed by the personnel of

the performing organization. This data will be entered into the NMIS when the service work is completed. The local data section provides an area for use by the individual Centers to satisfy requirements particular to their metrology programs only. The reverse side of the Metrology Control Document is used by the performing organization to enter specific instrument service data as required by the individual Center's documentation procedures.

TABLES

The NMIS contains seven tables (fig. 7) that are unique to the system while utilizing five NEMS tables. These tables are used to provide necessary data for updating transactions and generating reports. Each table has a data element in the NEMS and/or NMIS equipment files as its key. A brief description of each table follows.

Table 20, Recall Identification Table (fig. 8), provides the keys to identify instruments according to a predetermined instrument classification. For example, standards are classified as Reference Standard (R), Transfer Standard (T), and Working Standard (W). In Situ Calibration (I) identifies those instruments requiring testing in the facility as opposed to those requiring calibration (C) in the laboratory.

Table 30, Condition Received Table (fig. 9), defines the operating condition of the equipment received by the performing organization. Analysis of this type of data provides information needed to adjust instrument recall calibration intervals and evaluate the overall effectiveness of a Center's metrology program. The codes A to I were developed from a consensus of the NASA Centers' representatives. Codes J to Z allow the individual Centers to define condition codes unique to their Center's operation.

Table 45, Action Requested Table (fig. 10), defines the instrument service requested by the user. Codes A to J were required by the majority of the Centers and codes K to Z provide for service requests that are unique to the individual Center's operation.

Table 50, Action Taken Table (fig. 11), defines the actions that were actually performed in completing the instrument service. This list of codes is very detailed and currently provides for only one Center unique code. This data enables detailed analyses of the structure of the work performed by the performing organization.

Table 50, Measurement Discipline Table (fig. 12), defines 13 work discipline areas into which work is divided. Codes N to Z are provided to allow the individual Centers to add disciplines that are unique to their operations. This data will allow for detailed analyses of the workload according to measurement disciplines.

Table 75, Performing Organization Table (fig. 13), provides identification of the organization performing the work. For example, Code E identifies that work was performed on a Center's Reference Standards by the National Bureau of Standards as opposed to those sent to a standards laboratory (Code D), or another government laboratory (Code G). Codes I to Z are established as Center unique to allow Centers having more than one identifiable calibration laboratory to track individual performing organization performance. For example, LaRC has eight organizations performing such work. This table also includes calibration and repair labor rates for each of the codes to calculate instrument and calibration repair costs.

Table 420, Transaction Number Table (fig. 14), lists the transaction codes identified for the operation of the NMIS.

The NEMS contains five tables used by the NMIS (fig. 15). However, since the NMIS will not have a centralized data base, Table 252, NASA Installation Number Table, will not be significant.

Table 40, Manufacturer's Code Table, contains codes assigned in the Federal Cataloging Handbooks, H-4 series, identifying each manufacturer. Additionally the code "XXXXX" is used when the manufacturer is known but the code needs to be assigned and the code "ZZZZZ" is used when the manufacturer is unknown.

Table 78, Custodian Account Number Table, contains the property custodian account numbers and custodian numbers, names, mail codes, and organizational codes required for property management.

Table 90, User Number Table, contains user numbers and names for employees at each Center. Some Centers' table 90 will also contain names of contractor employees.

Table 102, Building Number Table, contains the numbers and names of buildings where equipment is located.

NMIS REPORTS

Through a coordinated effort of the workshop, 18 reports (fig. 16) were developed to monitor instrument and calibration laboratory performance. Since the detailed development began in October 1983, 10 additional reports (fig. 17) have been developed. The frequency of individual issuance, determined by consensus of projected Center usage, varies from a daily generation to a yearly generation with nine reports issued by request only. Additionally, if the standard frequency report issuance schedule does not meet a particular Center's needs, provisions are made to easily change the frequency.

A brief description of each report follows.

ECN Calibration Master List (Report 001).- This report lists, in Equipment Control Number (ECN) sequence, all instruments contained in NMIS. Each record shows ECN, item name, manufacturer's name, model number, date calibration due, measurement discipline, performing organization for last service, and recall identifier. Report prints total number of line items. This report is generated quarterly and has no other selection criteria.

Calibration User List - ECN Sequence (Report 002).- This report lists all instruments in the system sequenced by custodian account number, user number, and ECN. Each record lists ECN, item name, manufacturer's name, model number, date NASA acquired, calibration interval, date calibration due, last eight condition received codes, measurement discipline, performing organization for last service, and recall identifier. This report provides the total number of instruments in each user account, each custodian account, and the grand total. Other report selection criteria provided include user number and custodian account number.

Calibration User List - Item Name Sequence (Report 003).- This report contains the same data as Report 002. However, it is sequenced by item name, manufacturer's name, and model number as opposed to the ECN sequence of Report 002. This report is issued on request only. No other selection criteria is provided.

Calibration Item Name List (Report 004).- This report sequences the instruments in the NMIS by item name and list manufacturer's name, model number, date NASA acquired, ECN, custodian account number, user name, calibration interval, last eight condition received codes, recall identifier, and date calibration due. Additional selection criteria include item name, item name - manufacturer's name, and item name - manufacturer's name - model number. This report lists the total number of named instruments for each manufacturer, the total number of named instruments and the grand total number of instruments. This report is issued annually.

Calibration Model Number List (Report 005).- This report lists instruments sequenced by model number, manufacturer's name, item name, and ECN. It contains manufacturer's name, item name, ECN, date NASA acquired, cost, custodian account number, user number, calibration interval, last eight condition received codes, recall identifier code, and date calibration due. Additional selection criteria include manufacturer's model number, manufacturer's name and manufacturer's name - model number. It lists the total number of instruments for each model number and the grand total number of instruments. This report is issued on request only.

Calibration Due List - ECN Sequence (Report 006).- This report lists by custodian account number and user number those instruments due for calibration and can be used as a calibration recall notice (fig. 18). The report is sequenced by each custodian account and user number, date calibration due, and ECN. This report contains item name, manufacturer's name, model number, calibration interval, measurement discipline, and performing organization. The report lists the total number of instruments due for each date, the total

number of instruments by both user and custodian account numbers and the grand total number of instruments due for calibration. Additional selection criteria include date calibration due, date calibration due - custodian account number, date calibration due - custodian account number - user number. This report is issued monthly.

Calibration Due List - Item Name Sequence (Report 007).- This report contains the same information as Report 006. However, it is also sequenced by item name for each custodian account number and user number. The additional section criteria is identical to that of Report 006. This report is issued on request only.

Calibration Due List - Performing Organization Sequence (Report 008).- This report lists the instruments due for calibration by performing organization and is intended to be primarily used by performing organization managers. This report is sequenced by performing organization, measurement discipline, item name, date calibration due, manufacturer's name, and model number. The report also lists ECN and calibration interval. Additional selection criteria are date calibration due and performing organization - date calibration due. This report is issued monthly.

Calibration Overdue List (Report 009).- This report lists those instruments which have not been submitted by a specified date and are overdue for calibration. The report is sequenced by custodian account number, user number, date calibration due, and ECN. It contains the same information as Report 007. It lists the total number of items overdue by user number, custodian account number, and the grand total number of items overdue. Additional selection criteria include custodian account number - date calibration due and user number - date calibration due. This report is issued monthly.

Performing Organization - Due/Overdue Status Report (Report 010).- This report lists the instruments that have not been completed by a specified date. This report is sequenced by performing organization, measurement discipline, date required, and ECN. It also provides manufacturer's name and model number. The report lists total instruments due for a given date, the total instruments due/overdue for each measurement discipline and for each performing organization. There is no other selection criteria. This report is issued on a daily basis.

Hold Status Report (Report 011).- This report lists those instruments which are not being actively processed in the performing organization's laboratory for such reasons as shipped for off-site repair or awaiting repair parts. This report is sequenced by performing organization, transaction date, and ECN. The report lists item name, manufacturer's name, model number, measurement discipline, and action taken code from Table 50. The report provides total number of items for each transaction date, performing organization, and the grand total number of items in the hold status. The additional selection criteria is by performing organization. This report is issued monthly.

Calibration Support Analysis (Report 012).- This report provides a total calibration and repair cost analysis in a year-to-date format and is sequenced by custodian account number, user number, job order number, and ECN. Data provided in this report include item name, labor costs, parts cost, outside service cost, total cost, and date instrument was last serviced. The report provides total cost by user number, custodian account number, and grand total costs for each category. Additional selection criteria is by job order, custodian account number, and user number. This report is issued annually.

Calibration Life Cycle Cost Analysis (Report 013).- This report provides total service costs to date for each instrument. The report is sequenced by item name, manufacturer's name, model number, and ECN. Data listed include date NASA acquired, cost of item, labor cost, parts cost, outside service cost, total cost, and average annual cost. Additional selection criteria include item name - date NASA acquired, item name - manufacturer's name - date NASA acquired, item name - manufacturer's name - date NASA acquired, item name - manufacturer's name - model number - date NASA acquired, and date NASA acquired - all. This report is issued annually.

Production Analysis (Report 014).- This report provides manpower data required for calibration, repair, and total service in hours to the nearest 0.1 hours. The report is sequenced by performing organization, measurement discipline, item name, and model number. The report includes technician identifier, ECN, manufacturer's name, calibration hours, repair hours, total service hours, and date last serviced. The report provides both total hours and total items by measurement discipline and performing organization. Additional selection criteria is by performing organization. This report is issued monthly.

Calibration Weekly Status Report (Report 015).- This report provides the listing of the total number of items completed sequenced by performing organization, measurement discipline, and ECN. The report lists manufacturer's name, model number, initiate date, date calibrated, date last serviced, action taken, and days late. The report provides, by performing organization, the total number of items completed, the total number and percent of items completed within a specified time frame. Additional selection sequence is by performing organization only. This report is issued weekly.

Calibration Maintenance Time Analysis (Report 016).- This report provides data describing the manpower required to service instruments sequenced by manufacturer's name and model number. This report lists total instruments calibrated, repaired, serviced; total calibration, repair and service hours; and average calibration, repair, and service hours. The report also lists the totals for these categories for each instrument manufacturer. Additional selection criteria is by manufacturer's name, and manufacturer's name - model number. This report is issued annually.

Out of Tolerance and Inoperative Instrument Report (017).- This report lists the instruments that were received in the calibration laboratory and coded B, C, D, E, F, or G from the Condition Received Table (Table 30). This report is sequenced by custodian account number, user number, condition received code, item name, manufacturer's name, and model number. Other data listed includes ECN, date NASA acquired, calibration interval, last eight condition received codes, date calibrated, measurement discipline, and performing organization for last service. This report lists the total number of out-of-tolerance and inoperative instruments for each custodian account and user account and the total number of instruments received for these codes for a specified month. Additional selection criteria includes custodian account number - date NASA acquired, user number - date NASA acquired, date NASA acquired - all, manufacturer's name - date NASA acquired, item name - date NASA acquired, manufacturer's name - model number - date NASA acquired, manufacturer's name - item name - date NASA acquired. This report is issued monthly.

Calibration Interval Analysis Report (Report 018).- This report provides data for evaluating the effectiveness of a calibration interval determination program for both calibration and limited calibration actions. The report lists those instruments which were calibrated within $\pm$15 days of the scheduled date and have condition received codes which identify instruments received in an operating condition. The report lists the percentage of instruments received in tolerance for both calibration and limited calibration. This report is sequenced by item name, manufacturer's name, model number, and calibration interval. The report contains data including ECN and last eight condition received codes. Additional selection criteria include item name - model number, item name - manufacturer's name - date calibration due and all - date calibration due. This report is issued annually.

Work Action Analysis Report (Report 019).- This report lists the instruments serviced by Action Taken Codes (Table 50) and provides a breakdown of the type of work being performed. This report is sequenced by action taken, performing organization, manufacturer's name and model number. The report lists data including ECN, item name, last eight condition received codes, total service hours, calibration interval, custodian account number, and user number. The report lists the total number of items and service hours for each performing organization and each action taken code. Additional selection criteria includes action taken and performing organization. This report is issued annually.

Property Location Report (Report 020).- This report lists the location of each item and is sequenced by equipment location building, room, and ECN. This report is different from a NEMS equipment location report in that it also includes the noncontrolled instruments while NEMS contains only controlled equipment. The noncontrolled equipment has a metrology number assigned to it for identification control only and not accountability. Data listed include custodian account number, date calibration due, manufacturer's name, model number, and item name. The report lists the total number of items

for each building. Additional selection criteria is equipment location building and custodian account number. This report is issued on request only.

Work Action Analysis Report - Summary File (Report 021).- Since it is not mandatory that all instruments at a field Center be included in the NMIS, the performing organization may be performing instrument service work that is not included in any of the previous analysis reports. This report and Report 105 were created to record specific data in a summary format for uncontrolled items. Report 021 lists by quarter the total number of items serviced for each of the action taken codes. This report lists the previous quarter's data when the second, third, and fourth quarter reports are issued. There is no other selection criteria. This report is issued quarterly.

Metrology File Detail Item List (Report 100).- This report contains the entire data record to date for each instrument contained in NMIS. This report lists all of the data elements identified as required for adequate metrology system control. This report has no additional selection criteria and is issued on request only.

Daily Transaction Report (Report 101).-This report lists the daily transactions in the NMIS and is sequenced by transaction number and ECN. The report also lists reference code, file data element, original entry and revised entry. There is no additional selection criteria and the report is issued daily.

ERROR Codes and Messages (Report 102).- This report lists all error codes and error-code messages used in the NMIS. This report is sequenced by error-code and is issued on request only.

Global Change Report (Report 103).- This report lists the global changes entered into the system and is sequenced by data element number. The report lists the changes from, changes to, data processed, reference code, and number of records changed. There is no additional selection criteria and the report is issued after each transaction and annually.

Metrology Control Document (Report 104).- This report is the Metrology Control Document which is the standard preprinted form for use in the NMIS.

Summary File Detail List (Report 105).- This report provides detailed information for those instruments not controlled by the NMIS but are serviced. This report when combined with Reports 012, 014, and 016 will provide the metrology manager with a more complete metrology system performance analysis. This report is sequenced by performing organization and action taken. The report summarizes data by action taken code such as repair hours, calibrate hours, labor cost year to date, parts cost year to date, outside service cost year to date, total number of instruments calibrated, total number of instruments repaired,and total instruments serviced. Additional selection criteria is by performing organization only. The report is issued quarterly.

Metrology History File Detail List (Report 106).- This report lists in detail all of the data elements required for an instrument record when stored in the history file. This report is identical to Report 100. This report is issued on request only.

CONCLUDING REMARKS

In 1982 the NASA Metrology and Calibration Workshop made the decision to develop an agency-wide metrology data management system which would operate in concert with the new NASA Equipment Management System (NEMS). The metrology system would be used by field Centers to recall instruments for periodic calibration, to evaluate instrument performance, to summarize and report metrology work performance, and to provide other technical and management data. Two meetings, at the Kennedy Space Center and the Jet Propulsion Laboratory, held in 1983 resulted in the development of the core data elements--some shared with NEMS, some unique to the metrology system. Codes for various work actions were adopted and applicable system tables developed. In addition 18 system output reports were developed. Another of the major accomplishments of these meetings was the preliminary design and adoption of the Metrology Control Document (MCD) and the commitment that each field Center would use it as a source document for the NASA Metrology Information System (NMIS). The Langley Research Center was assigned lead responsibility in the development of NMIS. During detailed development, over a period of 7 months, several additional data elements were identified, 10 additional reports were developed, issuance frequency for reports was established, CRT screen formatting completed, the MCD design completed, and the draft of the NMIS design document compiled and distributed. Planned future activities include a detailed Design Document Review by NASA metrologists at the Langley Research Center (LaRC) in May 1984 and the initial system demonstration scheduled for July 1984 at LaRC. The NMIS is scheduled for installation at LaRC during the last quarter of calendar 1984 with second Center installation initiated in January 1985. Installation plans for the other Centers will be established at the next Metrology and Calibration Workshop to be held in October 1984.

NMIS/NEMS Data Element	Description
M-10/E-10	* Equipment Control Number (ECN)
M-15/E-12	Old Tag Number
M-90/E-200	* Labor Cost Last Service
M-95/E-202	* Labor Cost Year to Date
M-100/E-204	* Labor Cost to Date
M-105/E-210	* Parts Cost Last Service
M-110/E-212	* Parts Cost Year to Date
M-115/E-214	* Parts Cost to Date
M-120/E-222	* Date Last Serviced
M-125/E-230	* Date Calibrated
M-130/E-232	* Date Calibration Due
M-135/E-30	* Item Name
M-140/E-40	Manufacturer's Code
M-145/E-42	* Manufacturer's Name
M-150/E-44	* Manufacturer's Model Number
M-155/E-46	* Manufacturer's Serial Number
M-160/E-60	* Date NASA Acquired
M-165/E-72	* Acquisition Document Control Number
M-170/E-78	Custodian Account Number
M-175/E-80	* Custodian Number
M-180/E-86	* Custodian Organization Code
M-185/E-90	* User Number
M-190/E-102	* Equipment Location Building
M-195/E-104	* Equipment Location Room
M-210/E-150	* Acquisition Cost

*Indicates identified by metrology workshop.

Figure 1.- NEMS data elements required by NMIS.

NMIS Data Element	Description
M-20	Recall Identifier
M-25	Recall Entry Date
M-30	* Condition Received
M-35	* Technician Identifier
M-40	* Calibration Interval
M-45	* Action Requested
M-50	* Action Taken
M-55	* Initiate Date
M-56	Transaction Date
M-57	Date Required
M-60	* Repair Hours
M-65	* Calibrate Hours
M-70	* Measurement Discipline
M-75	* Performing Organization
M-80	* Date Repaired
M-85	* Outside Service Cost Last Service
M-86	* Outside Service Cost Year to Date
M-87	* Outside Service Cost to Date
M-166	Job Order Number
M-200	Date Loaned Out
M-205	Date Loaned Due In
M-400	Reserved for Local Data
M-410	Reference Code
M-420	Transaction Number

*Indicates identified by metrology workshop.

Figure 2.- NMIS unique data elements required.

Figure 3.- NMIS instrument identification tag.

METROLOGY CONTROL DOCUMENT

USER INFORMATION

1. ITEM NAME		2. MANUFACTURER		3. EQUIP. CONTROL NO.	
4. MODEL NO.	5. SERIAL NO.	6. USER NAME			7. USER ID.
8. BLDG. NO.	9. ROOM NO.	10. CUSTODIAN NAME	11. CUS. NO.	12. CUS. ORG.	13. OLD TAG NO.	14. DATE CALIBRATION DUE

BACKGROUND INFORMATION

1. ACQ. DATE	2. ACQUISITION COST		3. ACQUISITION DOCUMENT NO.		4. CAL. INT.	5. REC. ENTRY DATE	6. DATE LAST SERV.
COST	7. LAST SERVICE	8. YEAR TO DATE	9. TOTAL TO DATE	10. CONDITION RECEIVED LAST × TIMES		11. ACTION TAKEN LAST × TIMES	
LABOR							
PARTS				12. REP. HRS. LAST × TIMES			
OUTSIDE SERVICE				13. CAL. HRS. LAST × TIMES			

USER-TM AREA

1. DATE REQ.	2. ACT. REQ.	3. WORK AREA	4. JOB ORDER	5. INITIATE DATE	6. T.M. APPROVAL
7. REMARKS					

CALIBRATE-REPAIR INFORMATION

1. JOB PRIORITY	2. ACT. REQ.	ACT. TKN.	4. COND. REC.	5. REP. HRS.	6. CAL. HRS	7. TOTAL HRS.	8. PARTS COST	9. REP. DATE	10. CAL. DATE
11. CAL. TECH.	12. REP. TECH	13. OUTSIDE SERVICE COST		14. DATE REC.	15. REMARKS				
16. LOCAL DATA									

Figure 4. NMIS Metrology Control Document - Front Side

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17. EQUIPMENT CONTROL NO.

18 ACCESSORIES RECEIVED

	A. POWER CORD		C. PROBES		E. COVER
	B. MANUAL		D. LEADS		F. OTHER

19 STANDARDS & TEST EQUIPMENT USED

A. IDENFITICATION NO.	B. CAL. DUE DATE	A. IDENTIFICATION NO.	B. CAL. DUE DATE	A. IDENTIFICATION NO.	B. CAL. DUE DATE

20. ENTER OUT OF TOLERANCE VALUES ONLY

A. TEST IDENTIFICATION	B. FUNCTION TESTED	C. NOM. VALUE	D. INITIAL VALUE	E. TOLERANCE	
				LOW	HIGH

21 PARTS REPLACED

A. SYMBOL	B. PART NO.	C. SOURCE	D. UNIT COST	E. QUANTITY	F. TOTAL COST

22. DATE TO AWP

23. DATE PARTS RECEIVED

24. REMARKS

G. GRAND TOTAL COST ▶

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Figure 5. NMIS Metrology Control Document - Back Side

INSTRUCTIONS FOR METROLOGY CONTROL DOCUMENT

NOTE: All dates, machine generated or hand written, are presented as MMDDYY

USER INFORMATION: 1--14 are preprinted upon form generation.

BACKGROUND INFORMATION: 1--13 are preprinted upon form generation.

USER-TM: (TM = technical monitor) User completes 1,2,5, and 8. TM completed 3,4, and 6, makes any necessary changes to 1,2,5, and 8, and certifies approval by signing 7.

2. ACTION REQUIRED CODES

"A" = acceptance test
"B" = special test
"C" = calibration
"D" = decontaminate/clean
"E" = limited calibration
"F" = functional check
"G" = maintenance
"H" = modify
"I" = repair
"J" = other
"K thru Z" center unique & maintained

4. WORK AREA CODES

"A" = acoustics, vibration, shock
"B" = pressure & vacuum
"C" = chemical & analytical
"D" = dimensional
"E" = electrical/electronic
"F" = frequency stds. & counters
"G" = radiometry & photometry
"H" = temperature & humidity
"I" = ionizing radiation
"J" = microwave & RF
"K" = oscilloscopes, waveform, video & communications
"L" = liquid & gas flow
"M" = mass, force, & torque
"N thru Z" center unique & maintained

CALIBRATION-REPAIR INFORMATION: 1 -- 15 completed by appropriate personnel in servicing organization or as local options dictate.
5,6,7 -- complete to XX.X manhours.
8 -- rounded to whole dollars from block 21- G.
13 -- rounded to whole dollar.

3. ACTION TAKEN CODES

"A" = acceptance test
"B" = special test
"C" = calibrated
"D" = decontaminated/cleaned
"E" = center unique
"F" = functional check
"G" = shipped for off site repair
"H" = hold (AWP, manuals, etc.)
"I" = returned to user unserviced
"J" = reject-beyond economical repair
"K" = reject-shipped for off site repair
"L" = limited calibration
"M" = maintenance
"N" = modified
"O" = other
"P" = adjusted-limited calibration
"Q" = adjusted-calibrated
"R" = repaired
"S" = repaired-limited calibration
"T" = repaired-calibrated
"U" = clean-adjust-limited calibration
"V" = clean-adjust-calibrate
"W" = clean-limited calibration
"X" = clean-calibrate
"Y" = clean-calibrate
"Z" = clean-repair-calibrate

4. CONDITION RECEIVED CODES

"A" = operative-in tolerance
"B" = operative-out of tolerence ≤1X
"C" = operative-out of tolerence >1X ≤2X
"D" = operative-out of tolerence >2X ≤4X
"E" = operative-out of tolerence >4X
"F" = operative-out of tolerence indeterminable
"G" = inoperative
"H" = not determined/applicable
"I" = other-see remarks
"J thru Z" center unique & maintained

LOCAL DATA: This section may be used, at local option, for any purpose desired. Any required programming is local responsibility.

REVERSE: General instrument service information. This section will be completed by servicing organization or as local procedures dictate.

Block 17 -- Equipment Control Number must be completed manually.

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Figure 6.- Instructions for completing Metrology Control Document.

Table Number	Table Name
20	Recall Identification Table
30	Condition Received Table
45	Action Requested Table
50	Action Taken Table
70	Measurement Discipline Table
75	Performing Organization Table
420	Transaction Number Table

Figure 7.- NMIS tables required

Code	Description
C	Calibration
F	Functional test
I	In situ calibration
N	Non recall
P	Preventive maintenance
R	Reference standard
S	Personal safety
T	Transfer standard
W	Working standard

Figure 8.- NMIS recall identification codes--
Table 20.

Code	Description
A	Operative - in tolerance
B	Operative - out of tolerance $\leq$ 1x
C	Operative - out of tolerance > 1x $\leq$ 2x
D	Operative - out of tolerance > 2x $\leq$ 4x
E	Operative - out of tolerance > 4x
F	Operative - out of tolerance - indeterminable
G	Inoperative
H	Not determined - not applicable
I	Other - see remarks
J-Z	Remaining values Center unique and maintained

Figure 9.- NMIS instrument condition received codes--Table 30.

Code	Description
A	Acceptance test
B	Special test
C	Calibration
D	Decontaminate/clean
E	Limited calibration
F	Functional check
G	Maintenance
H	Modify
I	Repair
J	Other
K-Z	Remaining values Center unique and maintained

Figure 10.- NMIS action requested codes--Table 45.

Code	Description	Code	Description
A	Acceptance test	N	Modified
B	Special test	O	Other
C	Calibrated	P	Adjusted - limited calibration
D	Decontaminated - cleaned	Q	Adjusted - calibrated
E	Center unique	R	Required
F	Functional check	S	Repaired - limited calibration
G	Shipped for off-site repair	T	Repaired - calibrated
H	Hold (awaiting parts, manuals, etc.)	U	Cleaned - adjusted - limited calibration
I	Returned to user unserviced	V	Cleaned - adjusted - calibrated
J	Reject - BER (beyond economical repair)	W	Cleaned - limited calibration
K	Reject - shipped for off-site repair	X	Cleaned - calibrated
L	Limited calibration	Y	Cleaned - repaired - limited calibration
M	Maintenance	Z	Cleaned - repaired - calibrated

Figure 11.- Action taken codes--Table 50.

Code	Description
A	Acoustics, vibration, shock
B	Pressure and vacuum
C	Chemical and analytical
D	Dimensional
E	Electrical/Electronic
F	Frequency standards and counters
G	Radiometry and photometry
H	Temperature and humidity
I	Ionizing radiation
J	Microwave and RF
K	Oscilloscopes, waveform, video, and communications
L	Liquid and gas flow
M	Mass, force, and torque
N-Z	Remaining values Center unique and maintained

Figure 12.- NMIS measurement discipline codes--Table 50.

Code	Description
A	Calibration/repair laboratory
B	Repair laboratory
C	Calibration laboratory
D	Standards laboratory
E	National Bureau of Standards
F	NBS map
G	Government primary laboratory (other than NBS)
H	NASA map
I-Z	Remaining values Center unique and maintained

Figure 13.- NMIS performing organization codes--Table 75.

Transaction Number	Transaction Name
01	Receipt of New Instrument by Inspecting Facility
02	Receipt of New Instrument by Receiving Facility
03	Receive Instrument for Recall
04	Return of Record from History File
05	Retagging
33	New Performing Organization
34	Send to Calibration
35	Send to Service
36	Return from Calibration
37	Return from Service
38	Cost (change)
39	Custodian Account (change)
40	User Number (change)
41	Instrument Location (change)
42	Loan Pool Out
43	Loan Pool Returned
44	Record Data (change)
45	Global (change)
46	Calibration Interval Adjustment
47	Factory Repair/Service
48	Recall Identifier
66	Modify Performing Organization
67	Lost Tag
68	Excess (broken)
69	Decontrol (removal of tag)
99	Discontinue Performing Organization

Figure 14.- NMIS transaction number codes--Table 420.

Table Number	Table Name
40	Manufacturer's Code Table
78	Custodian Account Number Table
90	User Number Table
102	Building Number Table
252	NASA Installation Number Table

Figure 15.- NEMS tables used by NMIS.

Report Number	Report Name	Frequency
001	ECN Calibration Master List	Quarterly
002	Calibration User List - ECN Sequence	On Request
003	Calibration User List - Item Name Sequence	On Request
004	Calibration Item Name List	Annually
005	Calibration Model Number List	On Request
006	Calibration Due List - ECN Sequence	Monthly
007	Calibration Due List - Item Name Sequence	On Request
008	Calibration Due List - Performing Organization Sequence	Monthly
009	Calibration Overdue List	Monthly
010	Performing Organization Due/Overdue Status Report	Daily
011	Hold Status Report	Monthly
012	Calibration Support Analysis	Annually
013	Calibration Life Cycle Cost Analysis	Annually
014	Production Analysis	Monthly
015	Calibration Weekly Status Report	Weekly
016	Calibration/Maintenance Time Analysis	Annually
017	Out-of-Tolerance and Inoperative Instrument Report	Monthly
018	Calibration Interval Analysis Report	Annually

Figure 16.- NMIS reports developed by metrology workshop.

Report Number	Report Name	Frequency
019	Work Action Analysis Report	Annually
020	Property Location Report	On Request
021	Work Action Analysis Report - Summary File	Quarterly
100	Detail Item List	On Request
101	Daily Transaction Report	Daily
102	Error Codes and Messages	On Request
103	Global Change Report	Annually
104	Metrology Control Document	On Request
105	Summary File Detail List	On Request
106	Metrology History File Detail List	On Request

Figure 17.- Additional NMIS reports required.

REPORT NO: 006

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
INSTALLATION NAME
NASA METROLOGY INFORMATION SYSTEM

PAGE ZZ9
RUN DATE MM/DD/YY

SEQUENCED BY: CUSTODIAN ACCOUNT NUMBER
USER NUMBER
DATE CALIBRATION DUE
ECN

CALIBRATION DUE LIST - ECN SEQUENCE

CUSTODIAN ACCOUNT NUMBER, NAME, M/S: XXXXX, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX, XXXXXXX
USER NUMBER, NAME, M/S: XXXXXX, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX, XXXXXXX

DATE CAL DUE	ECN	ITEM NAME	MANUFACTURER'S NAME	MANUFACTURER'S MODEL NUMBER	CAL INT	MEAS DISC	PERF ORG
999999	XXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXX	99	X	X

after change in Date Calibration Due:

TOTAL NUMBER OF ITEMS DUE: ZZ,ZZ9

after change in User Number:

TOTAL NUMBER OF ITEMS: ZZ,ZZ9

after change in Custodian Account Number:

TOTAL NUMBER OF ITEMS: ZZ,ZZ9

GRAND TOTAL NUMBER OF ITEMS: ZZ,ZZ9

1. Sequence: Custodian Account Number (M-170)
User Number (M-165)
Date Calibration Due (M-130)
ECN (M-10)

2. Page Break: User Number
Custodian Account Number
Maximum Number of Lines Per Page

3. Section Break: Date Calibration Due

4. Total Level: for Date Calibration Due
for User Number
for Custodian Account Number
Grand Total

5. Selection Criteria: Date Cal Due
Date Cal Due/Custodian Account Number
Date Cal Due/Custodian Account Number/
User Number
All

6. Distribution:

7. Frequency: Monthly

Figure 19.- Format of instrument calibration due report.

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LANGLEY'S VIEWS ON NEMS

BY

Jeanette W. George, Computer Systems Analyst
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The NEMS system consists of seven Center files and one Langley-unique file, the Prior Monthly Transactions (PMT). The NEMS Monthly Transaction file contains the current activity of the working month and is emptied to begin a new month. Since there was insufficient time to get all the information needed from this file before it was purged, we requested that the PMT file be established. This file assists our users in generating statistical information on data for periods greater than 1 month. It is also used to determine employee workload and productivity and has been beneficial as an audit trail on our items. The PMT file will be maintained for 12 months.

In order for anyone to access the NEMS on-line system, he must first have his USERID set up. Whenever an attempt is made to enter NEMS, the system checks the USERID against the NEMS USERID/AUTHORITY Table and, if it is not on the table, all access is terminated. A user may have access to all or part of a subsystem, or may not have access to a particular subsystem at all, depending on the level of authority given him.

There are five NEMS on-line subsystems. They are all menu driven with formatted screens. The main menu will display only the subsystems the user is authorized to use. Each subsystem can have various levels of authorization within it.

The NEMS Batch System consists of a series of jobs that perform various functions ranging from data base updating to reporting to data base maintenance. It is designed to run after the on-line system has been brought down. A NATURAL program submits the scheduled jobs and monitors their progress. All job submission and restarting is automatic and is initiated by the same NEMS job.

JCL used to run the various batch reports and maintenance functions is contained in one place. The JCL is automatically submitted to the internal reader by the JCL Generator programs based on control switches set in the records. For instance, if we are running the monthly cycle, only JCL card images with the monthly switch are selected.

A control record is used to monitor the job flow and the status of each job. This record is used to check for the completion of all jobs. At the end of the batch system, or if a fatal error occurs, a journal report is produced. It serves as an activity log for the run for that day.

As with all new systems, it is not unusual to encounter various problems. After 2 months of actual production it was decided that BDSD and Equipment Management personnel would document problem areas and situations experienced with NEMS. The documentation included changes we needed at Langley as well as other items we felt would assure smooth installation at other Centers. The documentation was transmitted to NASA Headquarters as an attachment to a letter from the Director for Management Operations. We identified 32 problem areas and/or concerns, with most being minor. Of the 32 items, 13 have been corrected and most of the others are in the process of being corrected.

One of Langley's greatest concerns is with the reconciliation between NEMS and the General Ledger. Langley's accounting system tracks cost data to the penny level. NEMS deals in whole dollar amounts. Therefore, we have no way of reconciling the two. The only approach that is acceptable to Langley, unless requirements for reconciliation are changed, is for the NEMS files and the reports involved in the process be at the penny level. All other NEMS reports can remain whole dollars.

Also to reconcile, Langley needs data to show the difference between the previous cost and the new cost for the month. On an input record, the adjustment amount is added to the cost and recorded as total amount. The adjusted cost is not captured. In order to establish a control between the prior months and the current month, a new field needs to be added to capture the adjusted cost (debits and credits). Langley has not reconciled the Equipment account with the General Ledger since February 1984.

Problems with NEMS regular production runs cause concern. Production at Langley is run on the second and/or third shift. If a run(s) terminates and/or abends in a particular module, we must wait until the next day to resolve NEMS problems after consultation with Headquarters personnel. Although Headquarters has given Langley excellent response in problem resolution, it is often difficult to define the problems by telephone. In addition, the NEMS users cannot use the system until problems are solved and the runs completed, which occurs in the next night's production.

NEMS is a very good system and has many outstanding features. However, for a successful installation, we must have (1) a good data base to convert to NEMS and (2) users and the data processing staff must work together.

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LaRC Local Area Networks to Support Distributed Computing

by: Ed P. Riddle
Langley Research Center

INTRODUCTION

LaRC has initiated the development of a Local Area Network (LAN) to support a growing distributed computing environment at the Center. The purpose of the network is to provide an improved capability (over interactive and RJE terminal access) for sharing multi-vendor computer resources. Specifically, the network will provide a data highway for the transfer of files between mainframe computers, minicomputers, work stations, and personal computers.

An important influence on the overall network design has been the vital need of LaRC researchers to efficiently utilize the large CDC mainframe computers in the central scientific computing facility. Although there has been a steady migration from a centralized to a distributed computing environment at LaRC in recent years, the work load on the central resources has increased. This same experience has been noted at other large computing facilities. Therefore, major emphasis in the network design has been placed on communication with the central resources within the distributed environment. The network to be implemented will allow researchers to utilize the central resources, distributed minicomputers, work stations, and personal computers to obtain the proper level of computing power to efficiently perform their jobs.

LaRC requirements for a local area network cannot be met with a commercially available system. As with almost all local area networks of any size, a custom design is required, including both hardware and software. LaRC has elected to minimize hardware design by building a network around commercially available Ethernet products. However, network and application level software for the network gateways and various resources on the network will be developed in-house. With today's LAN technology, an in-house design of the network software appears to be the only viable approach to meet LaRC requirements. Following is a review of LaRC plans for the development of a center-wide local area network.

NETWORK CONFIGURATION

Figure 1 defines a proposed framework within which an integrated data network to support distributed computing at LaRC will be developed. The top half of Figure 1 depicts the central scientific computing resources which include multiple CDC Cyber mainframe computers and a large mass storage system with a current capacity of 16 billion words. A major resource at the central facility is a CDC Cyber 203 vector processing supercomputer. The bottom half of Figure 1 depicts the growing distributed environment at LaRC.

The total network configuration consists of three levels of network with the principal difference between the levels being transmission speed. Three different networks are used because it is not economically feasible to implement a single network with today's technology to meet LaRC's networking requirement. The design goal will be to integrate the different levels of network to form what will appear as a single networking environment to the user.

Two levels of the network are already in existence at LaRC. An interactive computing low-speed network has been in operation for six years. The interactive network is shown in more detail in Figure 2. The network supports up to 9600 baud interactive terminal traffic to various computing resources at LaRC. The heart of the network is a digital data switch from Micom Systems, Inc. located in the central scientific computing facility. The data switch operates similarily to a telephone company central office switch. Any terminal on the network can initiate a connection to any computer (or terminal) on the network. Although installed initially to support scientific computing, the network has in recent years been expanded to support administrative computing as well. Requirement for a low-speed networking is expected to continue into the foreseeable future, although the implementation might, in the future, be part of an integrated voice/data PBX.

A high-speed mainframe computer network was installed in the computer center last year. This network, Control Data Corporation's Loosely Coupled Network (LCN), provides interconnection between the CDC mainframe computers and the mass storage system in the central facility. Three parallel coax trunks, each operating at a transmission rate of 50 megabaud, are used as the transmission medium.

To optimize the value of a distributed computing environment, a means for efficiently transferring large data files between all network resources is required. The two existing networks are not suitable for this. The interactive terminal network is too slow. It is limited to data rates of 9600 baud and typically does not provide a means for guaranteeing error-free transmission. The high-speed LCN network, although fast enough, is too expensive. The cost to interface a resource to LCN is $50,000 to $100,000--obviously not practical for workstations, personal computers, and most minicomputers. A new medium-speed network is needed to fill the gap between the existing networks and provide a reasonable and cost effective means for transferring data files within LaRC's distributed computing environment. Therefore, a network is being developed to support throughput up to one megabaud at a hardware cost-per-device of less than $3000. The new network, shown at the bottom of Figure 1, will have a gateway to the high-speed LCN mainframe network. A description of the proposed medium-speed network follows.

MEDIUM-SPEED FILE TRANSFER NETWORK

The proposed configuration of the medium-speed file transfer network is shown in Figure 3. The network is designed around Ethernet technology and products. Ethernet was chosen because it has received by far the greatest amount of commercial acceptance and support. Ethernet hardware is currently available commercially to interface with more computer systems, (including DEC minicomputers and IBM personal computers), than any other LAN product. The number of supported devices is growing rapidly.

The design concept is that each building, or group of buildings, will contain an independent Ethernet network to which minicomputers, workstations, and personal computers will be attached. The individual Ethernet clusters will then be interconnected via gateways to a ring network using token-passing LAN technology. Both the Ethernet and ring networks operate at a 10 megabaud transmission rate. Two network technologies will be integrated because it is not technically feasible to implement a single Ethernet extending to all of the LaRC buildings. The total distance exceeds the one mile limitation of Ethernet. The token-passing ring does not have this distance limitation. The multiple Ethernet design allows local data traffic within an Ethernet cluster to be confined to that cluster and not impact traffic on other parts of the network. This is an important consideration since our surveys have indicated that 50-70% of total data traffic will be local.

A dedicated gateway on the ring network will provide access to the high-speed CDC LCN mainframe network. The integrated network as configured in Figure 3 will allow interconnectivity between network devices.

NETWORK CHARACTERISTICS AND CAPABILITIES

It has been necessary to set boundaries on network capability in order to develop and implement a LaRC network using reasonable resources (manpower and money). The following summarizes the capabilities of the network.

The network will support full interconnectivity: any network device will be able to communicate with any other device at both a network and application level. To provide that interconnectivity, however, it has been necessary to limit (at least initially) the kinds of equipment and the applications that will be supported. Initial implementation will accommodate only CDC Cyber mainframe computers, DED PDP/VAX minicomputers, and IBM personal computers. File transfers will be the only application initially supported.

Even though the transmission rate on the network will be 10 megabaud, the maximum throughput between any two network devices will be limited by the device throughput, which typically has been found to be less than one megabaud. All network gateways will be designed to support throughputs up to one megabaud.

The packet scheme of transmission on both the Ethernet and ring networks provides for re-transmission of data when communication errors are detected, resulting in negligible error rates on the network.

An important design criteria has been that no modifications to the computer operating systems should be required to accommodate the network software. All network software has been designed to operate external to the computer operating systems.

Finally, the network is being designed with the future in mind. The goal of the design is a network that is easily expandable and adaptable to new LAN technologies. The latter is important because rapid advancements in LAN technology result in new and improved concepts and products almost daily.

IMPLEMENTATION PLAN AND SCHEDULE

The development and implementation of the network will be in four phases. The first phase, which is now well underway, is a pilot implementation in LaRC's central scientific computing facility. The pilot effort will be completed by the end of this calendar year. The second phase will be a production implementation of the network, beginning next year, at three to six selected sites. Refinements to network design are expected to be made as a result of experience gained during the first year of production activity. The third and fourth phases of network implementation will be a continuation of production implementation at additional sites. The last phase is expected to be completed by the end of calendar year 1986.

STATUS OF NETWORK DEVELOPMENT

Installation of a ten-station Ethernet pilot network in the central computing facility has been completed. The pilot includes a CDC Cyber mainframe computer, four DEC minicomputers, and five IBM personal computers. This equipment was not purchased for the network project but is equipment that was, and continues to be used for production work. An initial, simplified version of network and file transfer software has been developed in-house for all network devices. Throughput rates of 100-450 kilobaud between network devices have been demonstrated. Typically, the limiting factor on throughput has been found to be disk I/O on the network devices. The pilot network is operational during normal working hours and is available for limited production use.

Two Ethernet clusters on the pilot have been connected to a two-node ring and primitive operation of that configuration has been demonstrated. A fully-operational three-node pilot ring with three Ethernet clusters is expected to be operational in the central computing facility by the end of this calendar year.

The work remaining during this calendar year will be to refine the network software that has been developed, adding multi-user capability and providing routing and flow control protocols that are required for the ring network.

1983 - 1992 LaRC NETWORK TOPOLOGY

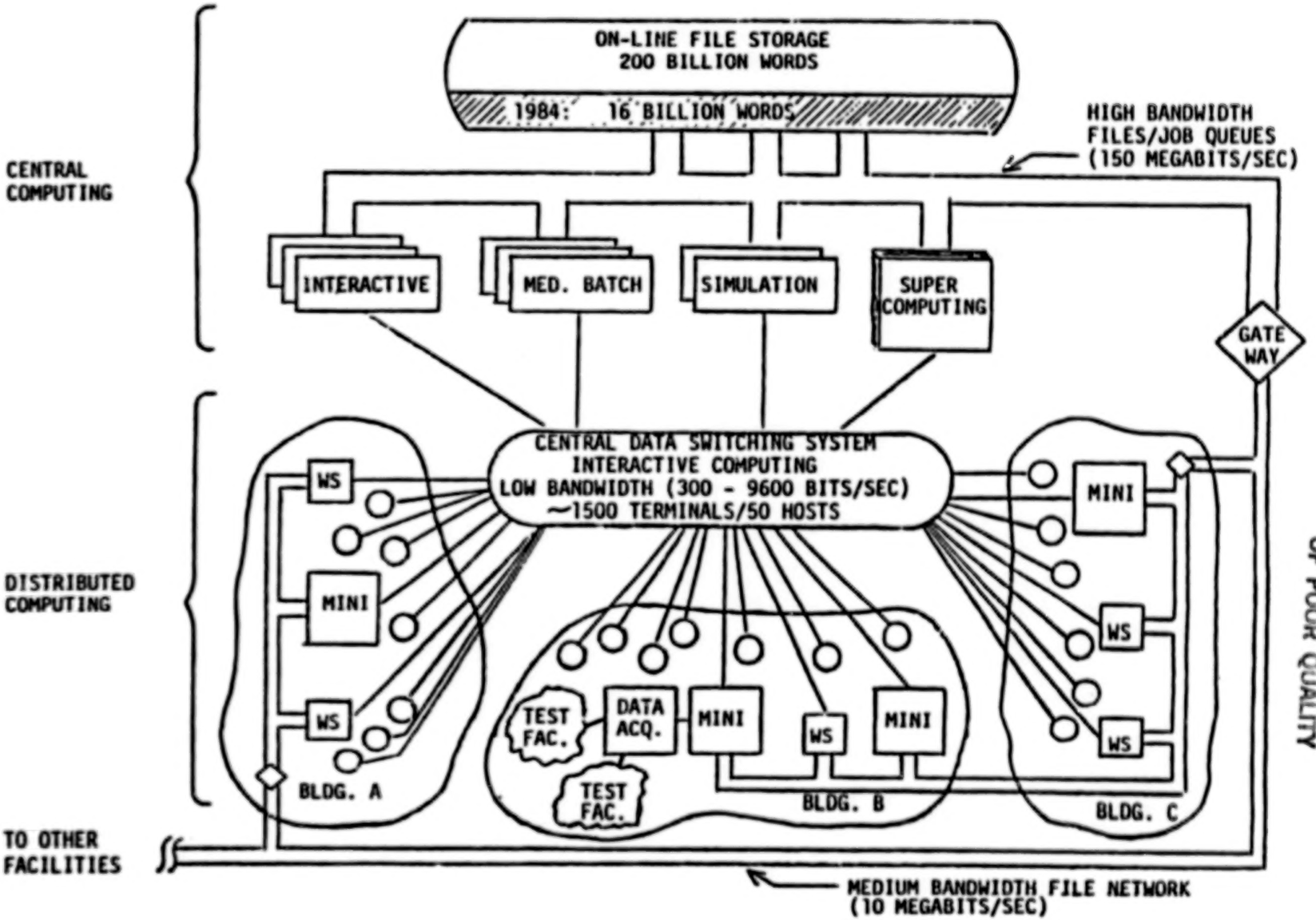

Figure 1

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LaRC INTERACTIVE TERMINAL ACCESS SYSTEM

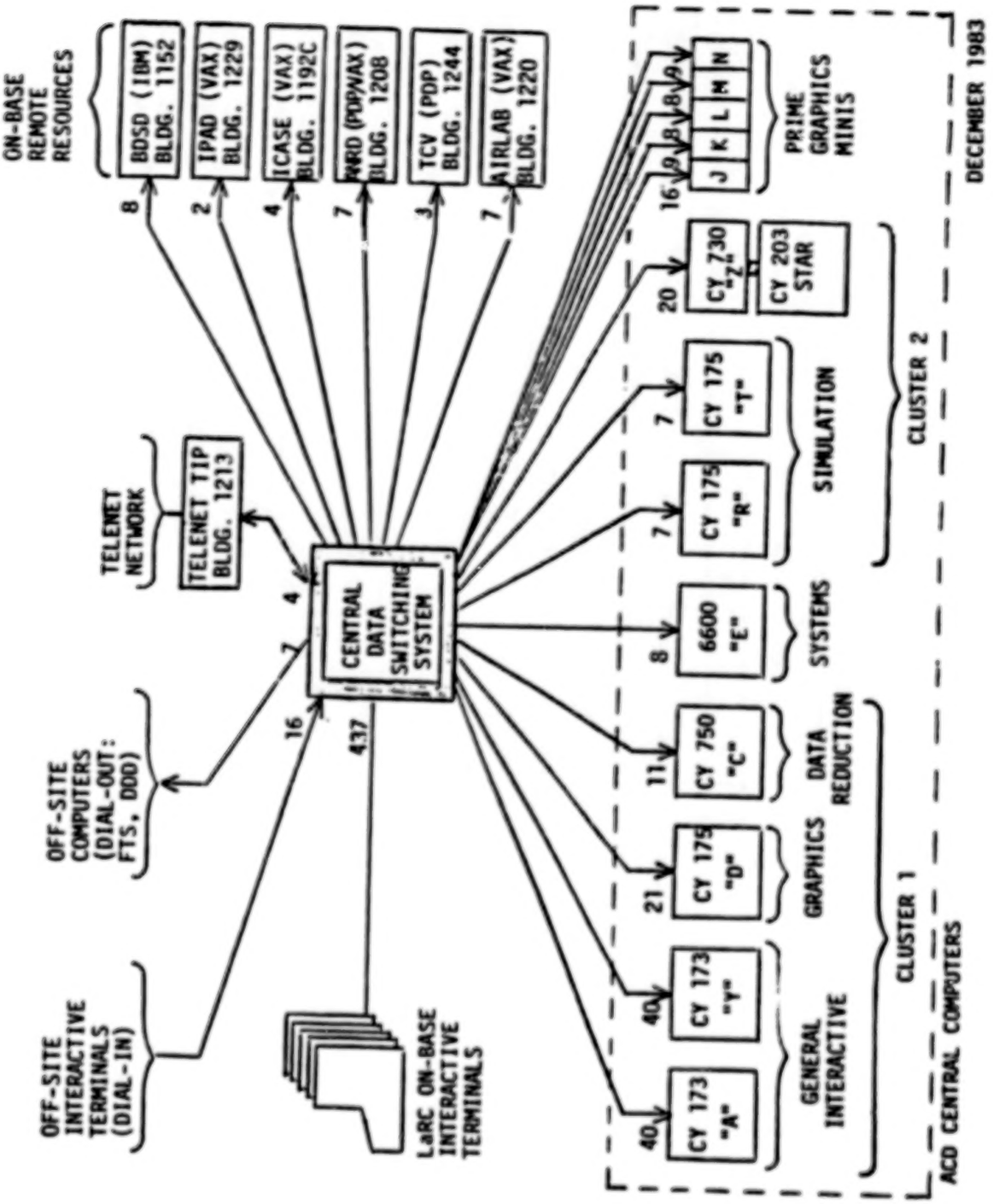

Figure 2

LaRC MEDIUM SPEED DATA NETWORK
(PROPOSED CONFIGURATION)

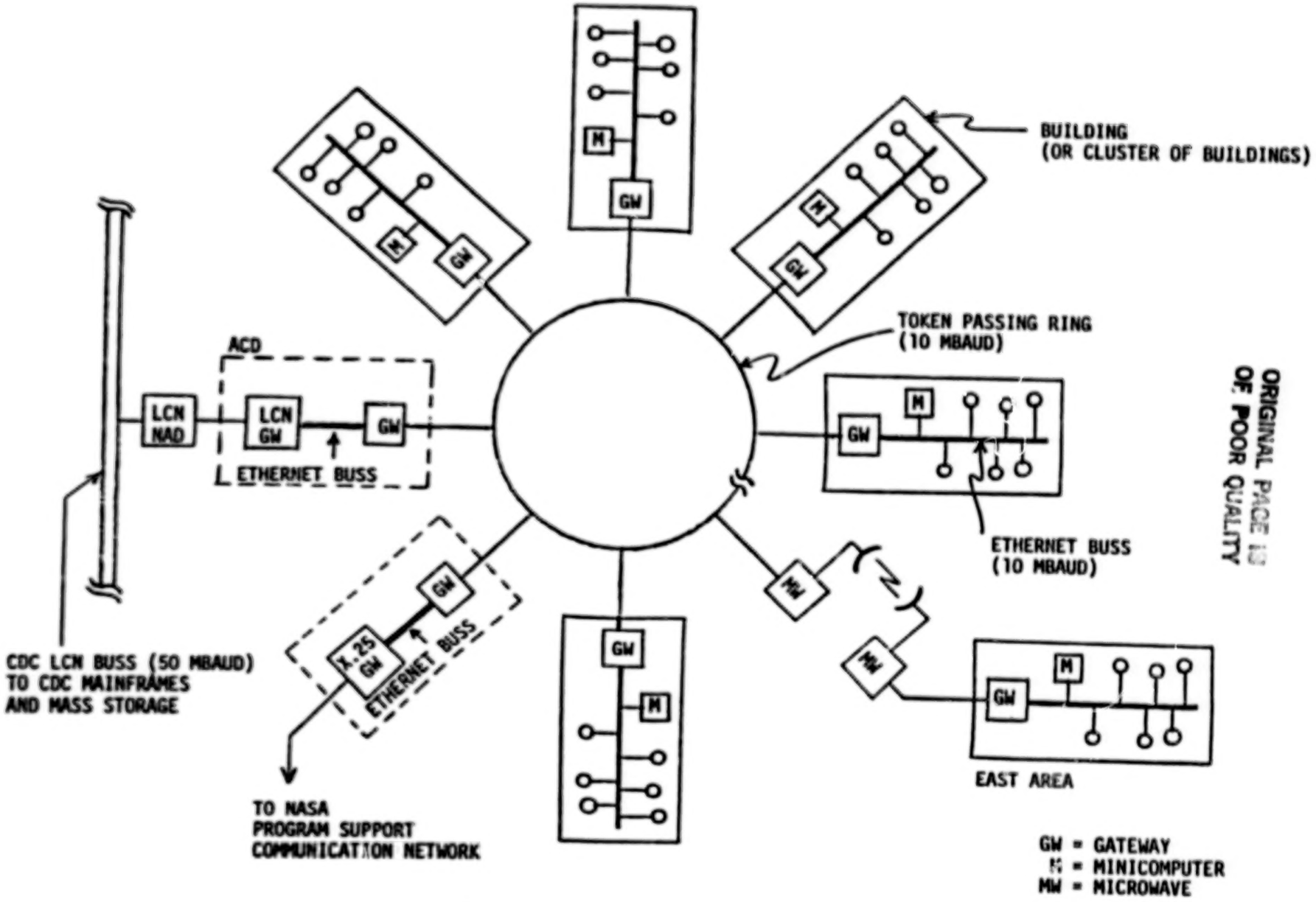

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Figure 3

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APPENDIX A

Administrative Data Base Management System
Technology Conference
June 6-7, 1984
LaRC Activities Center
AGENDA

June 6, 1984

9:00	Opening Remarks and General Announcements (LaRC/Andrew Swanson & NTD/Jim Radosevich)
9:15	Strategies for Converting to a DBMS Environment (ARC/Dave Durban)
9:50	Effective Organizational Solutions for Implementation of DBMS Software Packages (ET-Space Telescope Dev. Div./BDM/Doug Jones)
10:17	Break
10:35	Administrative Automation in a Scientific Environment (GSFC/Joyce R. Jarrett presented by: E. R. Schmerling)
11:05	The Administrative Window Into the Integrated DBMS (KSC/Georgia H. Brock)
11:23	Lunch
1:00	A User View of Office Automation or the Integrated Workstation (GSFC/E. R. Schmerling)
1:32	Langley Experience with ADABAS/NATURAL (LaRC/Andrew Swanson, Coordinator) -Strip and Load Data(LaRC/Richard Jones) -Natural Graphics (LaRC/Richard Jones) -File Transfer to IBM PC's (LaRC/Jerome Hoerger) -Status Tracking System for Reports(LaRC/Jean Huffman) -Acquisition Support Systems (LaRC/Vernon Vann) -Financial Management Support Systems (LaRC/Judy Evans) -Personnel Management Support Systems (LaRC/Sidney Pauls)
2:50	Break
3:00	Langley Experience with ADABAS/NATURAL - Continued (LaRC/Andrew Swanson, Coordinator)
3:50	Roundtable Discussion Concerning Technical Considerations in: (LaRC/Andrew Swanson, Coordinator) - Use of ADABAS/NATURAL - Use of COM-PLETE versus CICS or TSO (or other TP Monitors) - Other "NASA Uniform Systems" Matters

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Administrative Data Base Management System
Technology Conference
June 6-7, 1984
LaRC Activities Center
AGENDA

June 7, 1984

9:00	The NBS Data Management Technology Program (NBS/Helen M. Wood presented by: Roy Saltman)
9:30	Data Communication Between Data Terminal Equipment and the JPL Administrative DBMS (JPL/R. Iverson)
10:05	Break
10:25	NASA Metrology Information System - A NEMS Subsystem (LaRC/Earl S. German Jr. and Fredrick A. Kern)
10:45	Roundtable Discussion Concerning NEMS (LaRC/Andrew Swanson, Coordinator) -Overview of NEMS & PACER (LaRC/Jeff Parker) -Langley's views on NEMS (LaRC/PRC/Jeanette W. George) -Response to Problems Identified (NIE/John Gaff)
12:00	Lunch
1:00	LaRC Local Area Networks to Support Distributed Computing (LaRC/Ed P. Riddle)
1:30	Approached to Management of Engineering Information (LaRC/Dr. Robert E. Fulton presented by: Charles Blackbourne)
2:00	Summary Remarks/Plans for Next Conference (HQ/Jim Radosevich)
2:15	Break
2:30	Tours of LaRC Facilities: 1. National Transonic Facility 2. Analysis and Computation Division Facilities 3. Langley Visitor Center
4:00	Adjourn

APPENDIX B

THIRD ADMINISTRATIVE DBMS TECHNOLOGY CONFERENCE
Langley Research Center

June 6-7, 1984

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ATTENDEES

AMES RESEARCH CENTER

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Rick Serrano, MS 255-2, FTS 448-5137

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Ronald Brunner, Code 206, FTS 344-7460
James L. Head, Code 206, FTS 344-6580
Damian B. Romano, Code 206, FTS 344-5487
E. R. Schmerling, Code 930, FTS 344-7000
Keith E. Thornton, Code 206.4, FTS 928-5546 (Wallops)

JET PROPULSION LABORATORY

Robert W. Iverson, Code 512-200, FTS 961-6975

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